

AUGUST 1982

# eti

ELECTRONIC  
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## THE AUSTRALIA TELESCOPE

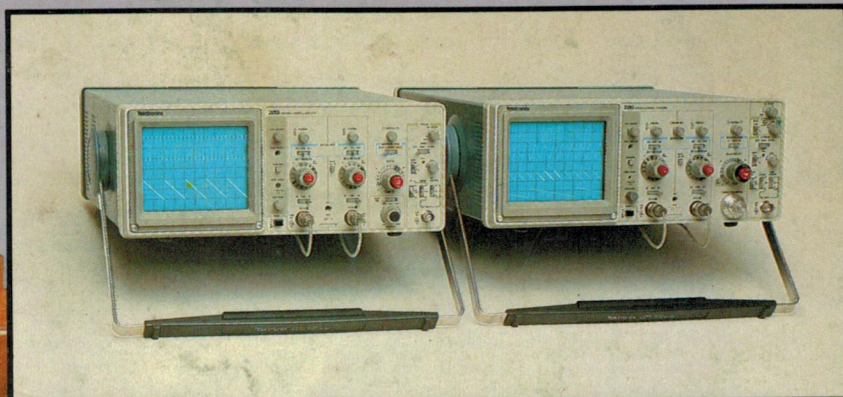
*Will Australian Radio  
Astronomy Move into  
the 21st Century?*

## FANTASTIC OFFER

NEW  
Tektronix CROs

12V Fluorescent  
Light Inverter  
To Build

"Catch '660"  
Computer Game



## Setting Up a Public Address System

## Turtle Robot Offer Extended | Beating the RS232 Blues





# Mousetraps and Cassette Decks

If you build a better mousetrap, the world will beat a path to your door. At Sansui, we built a better cassette deck—the D-770R—and it's proving the truth of that old adage.

How is it better? First, auto reverse occurs so quickly (0.6 sec.), you'll hardly notice an interruption in your music, whether you're listening or recording. Second, the D-770R has convenient automatic features like Dual Memory and 15-program AMPS (Automatic Music Program Search). Third, we

provide an electronic 4-digit tape/real-time counter. Yet another way the D-770R is better is new Dolby\* C noise reduction, which provides a very high S/N ratio of 80dB.

Now you've seen a few ways Sansui products are better, so beat a path down to you nearest Sansui sales outlet today and see our complete lineup.

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*Roger Harrison*

Roger Harrison  
Editor

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# ELECTRONICS TODAY INTERNATIONAL



This month's feature, courtesy of the CSIRO, gives the background to the Australia Telescope proposal — a project that will allow Australian Radio Astronomy to lead the world, from now into the 21st century, if government funding permits. Picture shows the model of a low cost dish antenna for part of the project.

Cover design by Ali White.

## news

### NEWS DIGEST 9

Information technology week; National delay Canberra chip shop; Kit constructors' manual; Vitalcall saves a life; etc.

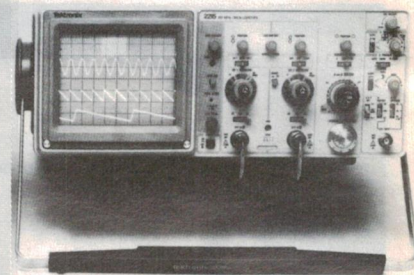
### PRINTOUT 79

Learning about micros with the Microprofessor; The Articulate Turtle; ZX81 RAM; Cromemco Personal Computer; and more, and more . . .

### LIFESTYLE NEWS 121

Powerline from Monster Cable; New Dynavector arm; New Sanyo video; New Technics turntable; etc.

## features



### TEKTRONIX CRO OFFER 14

Here's your chance to buy one of the superb Model 2213 or 2215 CROs at a very special price!

### THE AUSTRALIA TELESCOPE 14

Will Australian Radio Astronomy, at the forefront of the field, be able to move into the 21st century? Here's the background to what could be a world-leading radio astronomy project — if the Federal Government provides the funds.

### TASMAN TURTLE KIT — OFFER EXTENDED 93

Yes — there's still time to get yourself a Turtle Robot kit, but don't waste time!

### GRAND HI-FI CONTEST 124

Last chance to enter our contest — over \$7000 in prizes to be won! You can win hi-fi gear from the top-drawer companies in the audio field. Enter NOW!

## projects



### 1505: FLUORO LIGHT INVERTER 34

This inverter operates from a 12 V battery and will drive one 40 W, two 20 W or one 20 W fluorescent tubes at about three times the light output of equivalent power incandescent lights!



## 161: DIGITAL PANEL METER

Featuring a 3½-digit liquid crystal display, this highly accurate digital instrument is simple to build, low cost and highly versatile. We'll be using it in later projects.



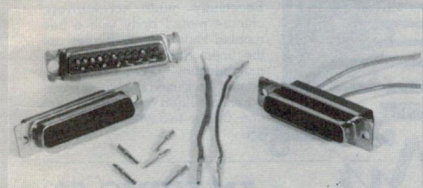
## 652: JOYSTICK INTERFACE

Add an Atari-type joystick to your System 80 for playing those games from Big Five or Adventure International — or just for drawing on-screen. Simple and low cost.

## computing

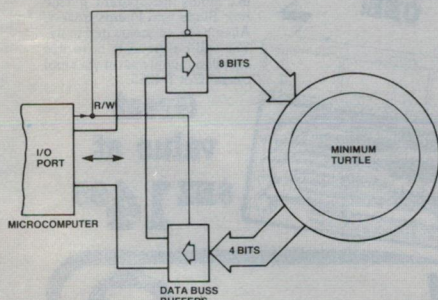
## COMPUTING TODAY

Dick Smith launches first approved, stand-alone direct-connect modem!



## RS232 BLUES

And how to beat them! A serial interface should be the simplest way to connect two computer devices. However, RS232 complicates matters. Here's how to uncomplicate things.



## TURTLE INTERFACING

Fundamentals of interfacing the Tasman Turtle robot to popular personal computers — with a suggested circuit.

## 55 TURTLE OFFER — STILL!

Offer extended — same price. Hurry.

## '660 SOFTWARE

Another colour program — 'Catch '660'. Plus — the Colour Patternmaker from last month explained. Full annotation.

## CHIP-8 COLUMN

Joint use of variables and how to move things around. A useful utility.

## lifestyle

## ELECTRONIC LIFESTYLE

Technics release Compact Disc PCM player; TriPad mat for turntables, etc.

## SETTING UP YOUR PA

How to set up an outdoor PA system, with particular reference to the ETI-498/499 project.

## POLK RTA-12B SPEAKERS

The Polks are different and the Polks are impressive — but not the 'reference monitors' they're claimed to be, according to Louis Challis.

## general

## MAIL ORDER BOOKS

Start your own library, claim them as a tax deduction or use them to help you out. More books than you ever thought possible to buy through one magazine. All from ETI's Book Sales Department.

## LAB NOTES

Using BiMOS and BiFET op-amps. Circuit techniques for the TL and CA series high input impedance op-amps.

## IDEAS FOR EXPERIMENTERS

LCD Tacho; probe finger guards; Symmetrical divide-by-three.

## IDEA OF THE MONTH

## SHOPAROUND

## ETI SERVICES

## DREGS

## next month

## 'UNIVERSAL' DC-DC INVERTER PROJECT

This dc-dc inverter can be configured to run from dc supplies of 12 V and upwards and can deliver power outputs up to 200 watts. Now you can drive our audio power amp modules from a 12 V battery etc, etc.

## XR2240 — SUPER TIMER!

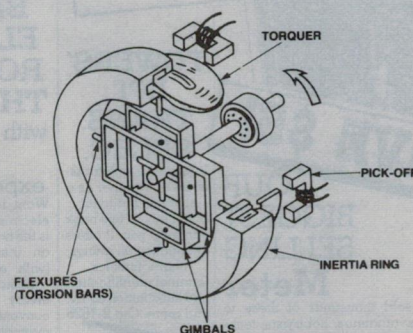
A Lab Notes on this super new timer that can produce accurate timing periods ranging from seconds to days!

## RS232 TROUBLESHOOTER

Having sorted out the ins and outs of the RS232 serial interface using the article in this issue, this follow-up article goes into the setting up and testing of RS232 interfaces. Very handy.

## PREY — APPLE GRAPHICS GAME

A predator/prey simulator game that demonstrates 'practical' use of Apple graphics. Fascinating.



## INERTIAL NAVIGATION

It took the human race over 900 years to progress from the primitive lodestone compass to developing a self-contained navigation system dubbed INS — the inertial navigation system. This article explains the background and how it works.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.



# BIG SAVINGS for NZ hobbyists

**YOU DON'T HAVE TO PAY THE EARTH FOR QUALITY TOOLS!**

Compare Dick Smith's prices to those you've been forced to pay in the past... And don't forget, we'll send any item anywhere in New Zealand from our Auckland Mail Order Centre.

## HOLE PUNCH SET

An absolute necessity for anyone who needs a large hole cut through metal. Very easy to use, needs no filing and will cut a hole without distortion. Comes with five punches (16, 18, 20, 25 & 30mm) and will handle steel up to 22 gauge and aluminium up to 16 gauge. Excellent value!

Cat T-4900

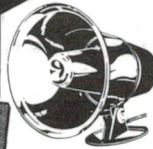
**ONLY \$NZ 15<sup>90</sup>**

Look after your deck!

## TAPE HEAD DE-MAG.

Improve the sound quality and protect your recordings with this tape head demagnetizer. Ideal for all audio tape decks (NOT video recorders) it simply plugs into 240V AC mains, and is held near the head, then drawn away slowly. Full instructions are supplied. Cat C-7222

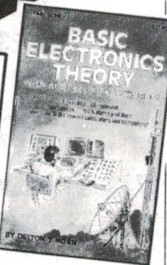
**and only \$NZ 14<sup>95</sup>**



## HORN SPEAKER

Here's a horn ideal for all PA work, burglar alarms, in fact any outside work because of its weatherproof nature. It has an impedance of 8 ohms and a power rating of 5 watts. It has a mounting bracket for easy installation and comes complete with lead. Cat C-2705

**only \$NZ 19<sup>95</sup>**



## BASIC ELECTRONICS THEORY

with projects & experiments  
Want to learn about electronics? Then this is the book for you. It is an introductory text (with experiments) of basic electronics theory. Also, it is a convenient reference manual, with almost any piece of information readily accessible. Cat B-1615

**A MUST! ONLY**

**\$NZ 17<sup>50</sup>**

## TOWERS' INT. TRANS. SELEC.

If you deal with transistors — whether as a student, hobbyist, buyer etc. — this book can help you. It offers information on ratings, characteristics, terminal identification and substitution equiv. and more. Cat B-1826

**NEW EDITION! ONLY \$NZ 27<sup>90</sup>**

**\$NZ 27<sup>90</sup>**

## Why pay more? Ferric Chloride

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## AMAZING CABLE JOINERS



Now you don't have to spend hours trying to join wires. These snaps make it so easy!

Cat H-6720 **only 85¢ NZ**

## 6 PIECE PRECISION DRIVER SET

Very handy to have around! Quality screwdrivers at a low, low price! Chrome plated, they are presented in a plastic storage case and consist of 4 blade drivers from 1.4mm to 2.9mm, and 2 Philips drivers, No's 0 and 1. Cat T-4360



**ONLY \$NZ 7<sup>95</sup>**

## 6 PIECE JEWELLERS DRIVER SET

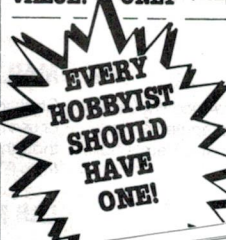


Beautifully made screwdrivers, chrome plated body with a free running knob on top. Blades are the finest quality nickel chrome molybdenum steel, precision ground. Presented in a handy transparent moulded case. Sizes range from 0.8mm to 3.8mm. Cat T-4350

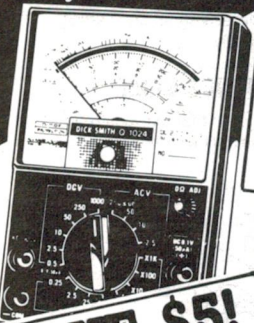
**EXCELLENT VALUE! ONLY \$NZ 6<sup>95</sup>**

## AMAZING 20 PIECE METRIC UTILITY SET

Great value for money! 20 pce nickel chrome molybdenum steel with chrome plated handle in a handy transparent plastic box. Blade and Philips drivers, Allen keys, spanners and more. You will be proud to have this excellent quality set in your tool range! Cat T-4365



**Great value at \$NZ 14<sup>95</sup>**



**SAVE \$5!**

## OUR BIGGEST SELLING Meter

We've sold thousands of these to students, amateurs, hobbyists, technicians... even repairmen! If you're into electronics as a hobby or as a business, and want a reliable economical multimeter this has got to be the one! Robust, high sensitivity, very easy to use. Comes complete with batteries, test leads and instructions. Cat Q-1024.

- 24 ranges
- 20,000 ohms per volt
- Diode protected movement

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- 1) Resistor pack: 300 computer selected 1/4w types. Cat R-7010... **only \$NZ 27.50**
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## Core Balance Relay

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Use as a stopwatch, countdown timer or event timer. Large LED and selectable timing rates between 0.01 and 1.0 secs. Cat K-3435

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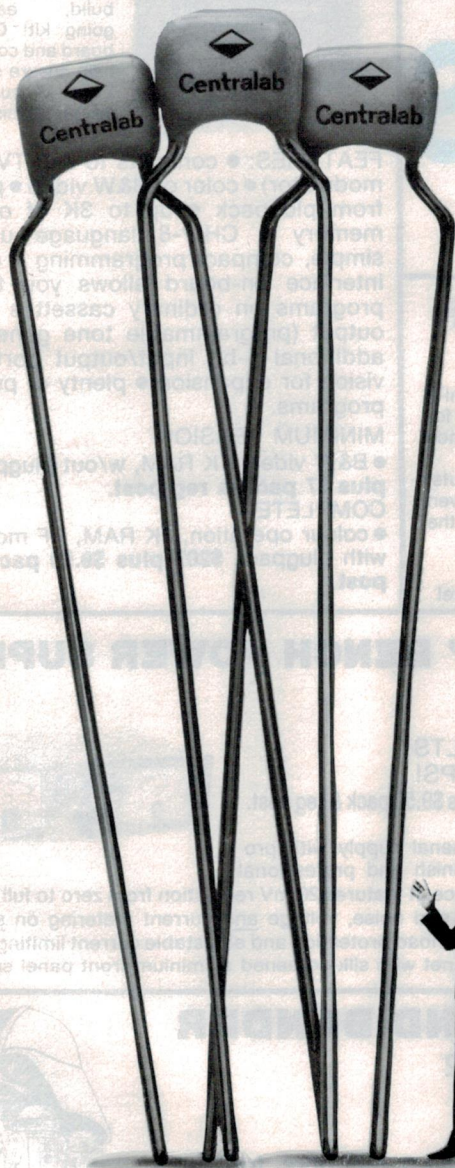
**Mail Orders: PO Box 9452 Newmarket NZ**

**Store Hours: Mon-Fri 8.30am to 5pm**





# Not all Monolithic Capacitors are created equal.



## ...Centralab by Philips.

While big on performance Philips monolithic Mono-Kap ceramic capacitors are very small in volume for use in circuit layouts where space is at a premium. Real value in a component package.

Manufactured by North American Philips — "Centralab"; these capacitors provide the designer with really high capacitances. And, because the chips are coated with epoxy they maintain complete environmental integrity.

The operational range of Philips Centralab capacitors span 10pF up to 10 $\mu$ F in three major series: NPO, X7R and Z5U dielectric types.

NPO, Negative Positive Zero series use COG dielectric to obtain ultra-stable capacitance over a very wide temperature range (+25°C to +85°C for example).

The X7R dielectric series are best used for general bypass, coupling and blocking with tight tolerances but where temperature stability is not so critical.

What should I use for basic bypass applications? The Z5U series is the answer with high K value to achieve even greater capacitance in similar package dimensions.

So when it comes to choosing the right quality capacitor, clearly Philips have the capacity to supply just the right component with Centralab.

For complete technical details on Centralab Capacitors or information about other capacitors in our range simply contact your nearest Philips Components office.

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Adelaide 243 0155 Brisbane 44 0191 Perth 277 4199



**Electronic  
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and Materials**

# PHILIPS



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Be proud of the projects you build. Our kits are presented with "professional" quality front panels (where specified), meters, knobs and components — everything, right down to the pc board. All AEC kits contain only top quality, prime specification components by recognised manufacturers. Give yourself and your project every chance of success. Don't be misled by "kits" which do not meet ETI and EA standards. Elsewhere you might pay less — but you get less. All parts are covered by manufacturers' warranty.

*All kits are sent by certified or registered post.*

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## PROGRAMMABLE TIMER-CONTROLLER

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Ideal for operating air-conditioning, fish tanks, hi-fi systems, tape recorders, slide and movie projectors for automatic displays, laboratory control etc — thousands of uses!

• This unit has four different programmable outputs, clock-controlled switch-on/switch-off times over a seven or eight day cycle (maximum). Selected days from the seven or eight day cycle may be 'skipped'.

**\$135 plus \$9.50 pack & reg. post**

Fantastic value! Nothing else like it available anywhere!

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No other kit metal detector can match this one — performs like ready-made detectors costing two or three times as much!

FEATURES: • VFL/TR design • Four modes of operation • ground balance control and auto-balancing button • adjustable length handle • pre-wound search head • professional finish • audio and meter indication • discriminates between ferrous and non-ferrous metals • adjustable sensitivity (rejects ring-tabs) • lets you know when to rejoice!

**\$193.50 plus \$9.50 pack and reg post**

We also stock lower-cost metal detector kits: ETI-549 induction balance metal detector with audio and meter indication — **\$53.40 plus \$5 pack & reg post**

ETI-561 BFO metal detector featuring low-drift crystal control and simple construction, audio output — **\$30.45 plus \$4.50 pack & reg post**

ETI-1500



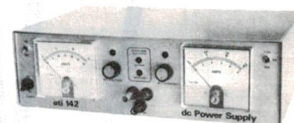
## 'PRO' BENCH POWER SUPPLY

ETI-142

0-30 VOLTS;

0-15 AMPS!

**\$221.99 plus \$9.50 pack & reg post.**



A phenomenal supply with professional finish and professional performance. It features 20 mV regulation from zero to full load, 10 mV ripple and noise, voltage and current metering on separate meters, overload protection and adjustable current limiting. Sturdy metal cabinet with silk-screened aluminium front panel supplied.

## 150W PUBLIC ADDRESS AMPLIFIER

### ETI-498/499



This compact design, employing ETI's fabulous, rugged, reliable 150W MOSFET amp module has features unequalled on any P.A. you'll buy 'over the counter'. Professional look silk-screened aluminium front panel and sturdy metal cabinet provided.

FEATURES: • two mic inputs • auxiliary input • preamp output (to other 'slave' amps or tape deck, etc) • insert jack for equaliser or howl-round stabiliser • low-Z and 100 V/70 V line outputs • 'speech-weighting' filter to improve clarity • ALC to provide 'punch'.

**\$252.22 plus \$11.50 pack & reg post**

## SOUND BENDER

### ETI-492

Amaze the neighbours, frighten the cat! This marvellous little project can change your voice to sound like Darth Vader or a Dalek. A versatile project, it can also be used for special effects on guitars etc.

**\$31.60 plus \$4.50 pack & reg post**





## Information Technology Week

Information Technology Week, the national event covering the present and future uses of computers and information processing, will be held in August 1982.

**According to Judy Hammond, ITW state co-ordinator for NSW, "ITW aims to increase the understanding and awareness in the whole community of information technologies, of which those using computers are the most significant. ITW also provides the community with the opportunity to interact with these technologies and take part in informed debate about them."**

Planned activities include an industrial robot display, a community group management game, hands-on self-learning courses at some educational institutions, film screenings, library displays and seminars and forums at selected metropolitan and country centres.

A series of papers entitled 'Technological Change — Impact of Information Technology, 1982' will also be available on request.

Primary school pupils may obtain a colouring book, which is being released along with a teacher's guide, and a floppy disk, containing information on convicts who were transported to Australia on the First Fleet, will be available to secondary school teachers, who may apply to the ITW State Secretary through their school principal.

Business houses will conduct open house displays on the application of new technology to their business. Typical examples will cover videotext, teletext, networking, word processing, micrographics communications and bar codes as applied to grocery identification.

Country and suburban chapters of the Australian Computer Society will be organising activities which suit their local needs. For example, the Wagga Wagga chapter will use a computer to record sales at their local cattle auctions.

Information Technology Week, sponsored by the Commonwealth Department of Science and Technology and the Australian Computer Society, is actively supported by State Governments and is organised by committees comprising members of the education, government and business sectors of the community.

ITW will be held during 15-21 August 1982 in all states except Queensland and Tasmania. Details of activities are available from the Department of Science and Technology in the ACT and all state capitals.

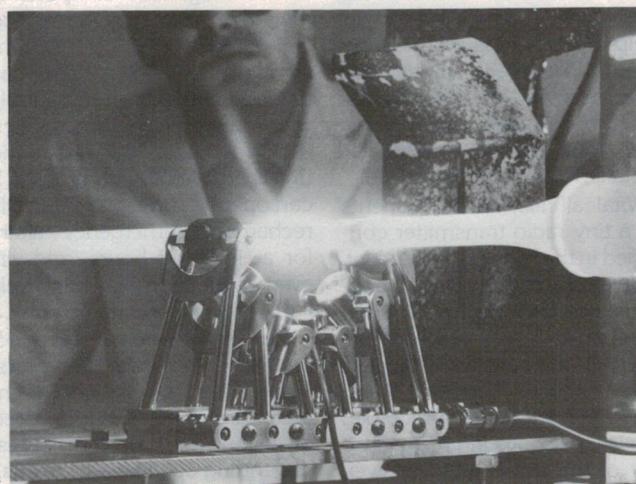
## National Semiconductor delays decision on Canberra plant

**National Semiconductor Corporation is delaying any decision on construction of a fabrication facility in Canberra (see 'Chip shop for Canberra', p.9 May 1981 ETI), until the company is able to make a reasonable forecast of capacity requirements, which is largely dependent on improvement in worldwide demand for its semiconductor components.**

The company said its Australian Government's "generous commitment to the construction of a large-scale facility and the favourable results of certain aspects of a 1981 feasibility study for such a plant construction notwithstanding, there is sizeable capacity available presently and expansion room at existing plants."

Medical saves a life  
When Mrs. Eva Voss's heart finally failed she had no time to ring for help on her telephone. Five seconds after the attack started she was unconscious on the floor.

### DIALLING A WORLD RECORD



The photograph shows a silica tube being processed into a preform rod, from which hair-thin optical fibre — so pure that a block 20 km thick would be as transparent as a window pane — will be drawn to form part of Britain's telephone network of the future.

The technique, called modified chemical vapour deposition, has been developed by British telecommunications engineers, who have recently set a world record by sending pulses of laser light over a 102 km length of optical fibre without the need for amplification along the route.

Unlike present light transmission methods, which allow the pulses to travel in up to 200 different ray paths, the researchers use a light-carrying core so small that it supports only one ray path. This greatly reduces the light spread and allows it to travel much further.

The team now plan to repeat their laboratory experiment by installing a fibre cable underground in a 30 km loop that will test the system under normal operating conditions.

ability to fully utilise its present sites is the company's primary goal.

"Under present-day conditions it is extremely difficult to predict when that goal will be achieved," a company spokesman said.

The company's study of the feasibility of such an extremely large fabrication facility, although the results were favourable in many aspects, did not substantiate making a decision at this time, he said.

A decision on a plant of that scope is more than likely several years away, the spokesman said.



## Vitalcall saves a life

**When Mrs. Eva Voss's heart finally failed she had no time to ring for help on her telephone. Five seconds after the attack started she was unconscious on the floor.**

Normally it could have been nine hours or more before anyone noticed her absence. But Mrs. Voss wasn't entirely without help. By clutching at a pendant around her neck as the first spasms seized her, she was able to summon help and save her life. Mrs. Voss's family had installed Vitalcall in her home.

Vitalcall has two components — a tiny radio transmitter contained in the lightweight pendant, and an electronic device connected to the telephone. When the pendant is squeezed, the Vitalcall unit automatically dials three chosen contacts and delivers a personal pre-recorded message requesting help; if two out of the three fail to answer, the unit alerts a 24-hour emergency team.

The pendant has been designed so that even arthritic and disabled people can use it with ease, and it operates within a range of 100 m from the telephone, which means that it can work effectively both inside and outside the house.

Every day the Vitalcall unit automatically reports to the central diagnostic computer at the Vitalcall centre, enabling staff to check that it is functioning correctly. Vitalcall also has an independent power supply which takes over automatically if a power failure occurs or the unit is accidentally unplugged. It can operate on its automatically rechargeable emergency battery for at least 48 hours, and will even continue to work effectively if the phone is left off the hook.

Full service rental costs \$5 per week, plus installation costs. There are flexible payment plans, and Vitalcall may be hired on a long or short-term basis, depending on individual needs.

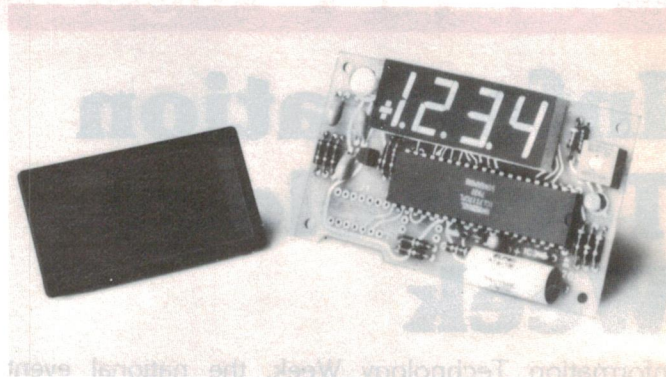
You can find out more about Vitalcall by contacting Denise Davis at Jaeger Associates on (02)357-5255, or Dr. Richard Thomson or Tony Ashworth at Vitalcall on (02)438-3311.



### WORK VK2DIK CHOPPER MOBILE!

DICK SMITH will be seeking contacts on the HF amateur bands during his round-the-world helicopter attempt from August to October. Equipment on board will be a Collins HF 220 sideband transceiver (USB only, though). Frequencies are: 80 m — 3750 kHz (USA & Canada); 40 m — 7060 kHz; 20 m — 14 250 kHz (14 140 kHz secondary, VE & VK); 15 m — 21 285 kHz (21 265 kHz secondary).

Approximate itinerary as follows: Fort Worth, US — 5 Aug.; New York — 8 Aug.; Greenland — 14 Aug.; Iceland — 15 Aug.; UK — 19 Aug.; London to Sydney — 12 Sept. to 3 Oct.; Sydney to Fort Worth — dates to be announced. Flights will take place during local daylight hours, normally in the mornings.



## New ac/dc-dc low RF noise converter

**Scientific Electronics, Australian designers and manufacturers of "high-quality" power supplies, have just released details of their newest unit — the SM135D1.**

The SM135D1 is an ac/dc-dc converter primarily intended for applications where a 12 V source with battery back-up is required. Facilities are provided to automatically boost and float charge a lead-acid battery, as well as disconnect the load if the battery is discharged to a detrimental level.

The SM135D1 will accept a dc input in the range 20 V to 65 V, or an ac input in the range 23 V to 46 V. The output voltage is nominally 13.5 Vdc, which is the optimum float voltage for lead-acid batteries.

The total available output cur-

rent to the battery and load is 10 A, with complete protection from both overloads and short-circuits and automatic recovery from either of these conditions. There is also automatic shut-down and recovery from over or under voltages on the input.

If at any time the battery voltage falls below 12 V a LED on the front panel will indicate that a low voltage condition exists, and a pair of isolated relay contacts can be used as a remote alarm indicator.

If the battery voltage continues to fall and passes below 11.4 V a relay disconnects the load from

## Switching regulator chip

**The uA494 voltage regulator contains all the 'building blocks' for designing a pulsewidth-modulated (PWM) switching power supply, including push-pull, bridge and series configurations.**

PWM operation results in a constant switching frequency, which simplifies output filtering and system stabilising.

Two on-chip uncommitted output transistors, capable of handling 200 mA source or sink current, are provided for push-pull operation. 'Dead Time' control assures that the two transistors are never on simultaneously. Single-ended or push-pull operation is selected via the output control pin. The uA494 operates at switching frequencies between 1 and 300 kHz with output voltages up to 40 V.

Other features include: an

internal adjustable oscillator, an internal 5 V reference, an internal error amplifier and a current-limit amplifier. Designed for high-power switching systems, the uA494 is used in applications requiring slaving or high frequency operation.

Available in both industrial military temperature-range versions, the PWM switching regulator is packaged in a 16-pin DIP. Further information from Fairchild, Suite 1, First Floor, 366 Whitehorse Rd, Nunawading Vic. 3131. (03)877-5444, or Sydney (02) 439-5911.



## Differential DPM

**Technical details on the Intersil DM-31 single-board differential 3½-digit DPM are now available from Elmeasco.**

The DM-31 comes on a 50 x 90 mm board and features 14 mm high red LED displays. The input bias is only 5 pA, input impedance 1000M. It requires only a single 5 V supply at 280 mA. The inputs are true balanced noise-rejecting differential inputs, and the meter has a hold function to freeze the last reading. It accepts user-supplied components for higher voltage ranges, current ranges and digital ohmmeter (to 20M) applications.

Details from Elmeasco, P.O. Box 30, Concord NSW 2137. (02)736-2888.

the battery to prevent permanent damage to the battery.

State-of-the-art design and filtering techniques have been employed to provide a unit with very low levels of radio frequency noise on both the input and output, according to Scientific Electronics.

The power supply has been designed according to Telecom Specification 1238, Regulated Power Supply Interface for Remote Subscribers. A transformer is available as an accessory to allow operation from the mains.

For further details, contact Scientific Electronics, 6 Holloway Drive, Bayswater Vic. 3153. (03)762-5777.

## Tektronix seminar on digital design

**Tektronix Melbourne will run a free seminar for engineers and engineering managers involved in microprocessor design and debugging.**

The half day seminar will be held at the University of Melbourne on Wednesday 18 August. The agenda covers applications in the digital design environment as well as a presentation of the latest Tektronix products for the digital designer.

Live demonstrations will include a Unix based multi-user software development unit, an

integration unit with microprocessor emulation and integration logic analysis and the first colour Digital Analysis system (incorporating word generation and logic analysis).

To register for the free seminar or for further information please contact Jill Radford at the Tektronix Melbourne office. (03)813-1455.

## Lightable keyboard modules

**Acme Electronics has introduced a new series of lightable keyboard modules with buttons that can be cheaply and neatly coded at the point when a keyboard is being assembled.**

Coding is quite simple — a slot in the button cap allows the assembler to insert an appropriately imprinted clear plastic tab. This is captured beneath the button top surface and subsequently illuminated by a lamp mounted in the circuit board.

Tabs can be improvised or cut from a pre-printed sheet. For convenience this sheet contains a full range of numbers,

letters, symbols and word groups.

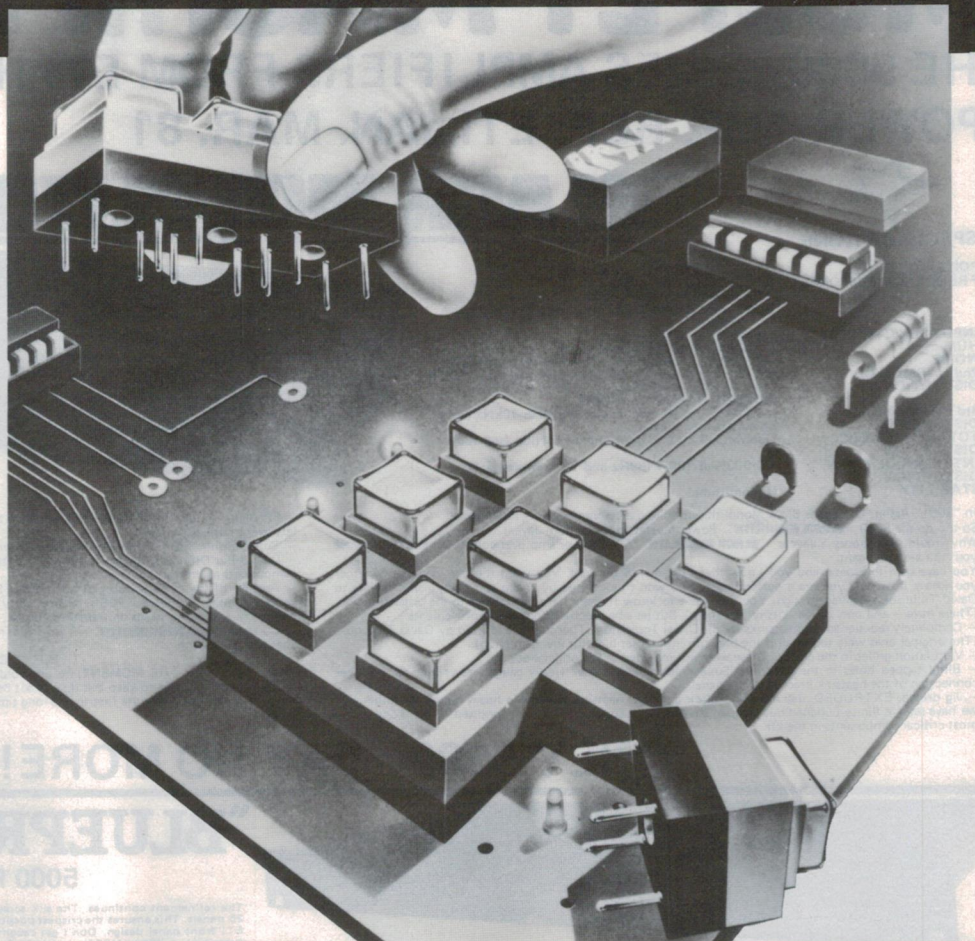
'Series 82' lightable keyboard modules are available in one, three and six-button configurations, with standardised dimensions for mix-and-match versatility. They feature a long-wipe design contact system for quick contact bounce (less than 10 ms) and long life (usually more than one million operations).

For further information, contact Acme Electronics, Melbourne (03)729-6211; Sydney (02)648-2255.

## Kit manual

**Electronic Agencies has recently produced a 'Kit Constructors' Reference Manual' that is included with every kit over \$20 but can be bought separately for a mere 50¢.**

The manual includes the basic things you need to know when you set about constructing a kit and should be a great aid for the hobbyist. It's chock-a-block full of useful data, hints and tips for constructors, in eight A4-sized pages. Get yours from one of their two stores, at 115 Parramatta Rd, Concord NSW, or 119 York St, Sydney NSW.





# MOSFET MAGNIFICENCE

THE 5000 SERIES AMPLIFIERS FROM ETI HAVE NO EQUAL  
POWER AMP. REF: ETI JAN. MAR. 81



## SPECIFICATIONS

### POWER OUTPUT FREQUENCY RESPONSE

Around 100W RMS into 8 ohms  
8Hz to 20kHz, +0 - 0.4dB  
2.8Hz to 65kHz, +0 - 3dB  
Note: these figures are determined solely by passive filters

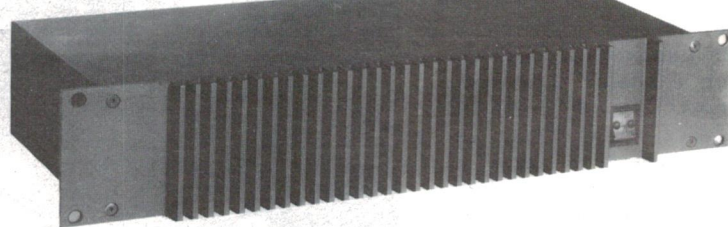
### INPUT SENSITIVITY HUM NOISE 2nd HARMONIC DISTORTION

1V RMS for 100W output  
- 100dB below full output (flat)  
- 116dB below full output (flat, 20kHz bandwidth)  
<0.001% at 1kHz (0.0007% on prototypes) at 100W  
output using a \*56V supply rated at 4A continuous  
<0.003% at 10kHz and 100W  
<0.0003% for all frequencies less than 10kHz and all  
powers below clipping

### 3rd HARMONIC DISTORTION TOTAL HARMONIC DISTORTION INTERMODULATION DISTORTION STABILITY

Determined by 2nd harmonic distortion (see above)  
<0.003% at 100W (50Hz and 7kHz mixed 4:1)  
Unconditional

In "2001" Arthur C. Clarke's Black Monolith symbolised awesome power - intelligence. So too do the 5000 "BLACK MONOLITH" Power Mosfet amp kits from Jaycar. Why would you choose a Jaycar "BLACK MONOLITH" 5000 Power amp over conventional kits? Because you, too are intelligent. You have seen the specs, and you know that this amp IS the best. You want the best because (whether you know it or not) you are a perfectionist. You won't be conned by cheap and nasty compromises to David Tillbrook's brilliant design. You will want to know if there have been mods to the original design. (There have - and only Jaycar kits reflect them). But let's be specific about the improvements. - Completely redesigned flag heatsinks for the Driver Transistors. Thoroughly endorsed by David Tillbrook. (The original ones were too small if the bias current was set high for low distortion). - Ventilation grilles in the covers. These were not included in the original design. - Blind tapped holes in the exclusive 'Superfinish' front panel. Heavy gauge screws used for stronger connection of the heatsink bracket to the panel. - Jig drilled, EXTRUDED, deburred and black anodised heatsink bracket in heavy gauge. All other kits we have seen, a flimsy punched out piece of sheet metal is supplied. Not even anodised!! This is one of the most critical components in the kit.



- Beryllium Oxide heatsink washers supplied. A tube of heatsink compound is also supplied - with enough left over to use elsewhere.  
- 'Superfinish' Front Panel. Despite what others may claim ours is still the best.  
- Dual 3 Pin DIN 30V Power Outlets. This extra power outlet enables you to power extra 5000 series components as they arrive on the scene.  
- And all of the extra features of our normal Superfinish 5000 amp, like: Metal 1% film resistors, Pre-wound Chokes, Fibreglass PCB's, Heavy Duty Earth Braid, Quality Capacitors, Original Chassis - bar design, Flux shorting straps on transformers etc., etc.  
The Jaycar "BLACK MONOLITH" is worth far more than the inferior kits around the market today. That goes without saying.

BUT IT COSTS NO MORE!

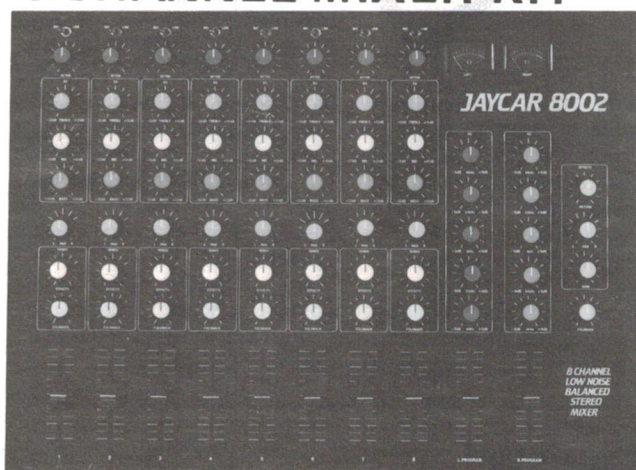
That's right. FOR THE MOMENT we are holding our price on this kit to a staggering low \$299. We probably won't be able to keep this quality kit below \$300 for long. We all enjoyed "2001" for the first time a long time ago now. You can enjoy your 5000 "BLACK MONOLITH" forever!

ONLY \$299- PAY NO MORE!!!

'Superfinish' Panel has  
Blind Tapped Holes



## AT LAST!!! THE NEW 8 CHANNEL MIXER KIT



1 Balanced (600 ohm) mic inputs/line inputs 1 Balanced output 1 Input attenuators 1 Cannon connectors included in the price 1 Bass, mid & treble equalization on each input 1 "Effects" (i.e. echo etc) capability 1 Foldback on all 8 inputs 1 Stereo pan on all 8 inputs 1 60mm slide faders used throughout 1 19" rack mount capability (or console mount) 1 Professional black front panel with format borders and multicoloured knobs to assist function identification 1 Designed for quick easy service 1 VU metering 1 Only high quality components used 1 5534A OP amp used for low noise and very low distortion.

BASIC MIXER KIT with all features. Includes 19" rack panel all knobs and electronic components AND 10 CANNON connectors \$495

Console mount chassis in steel, plated and pre-punched. Includes power supply for mixer and wooden end pieces. \$98

OUTPUT SHORT-CIRCUIT PROOF



## "BLUEPRINT" \* \* \* 5000 PREAMPLIFIER

The refinement continues. The silk screen stencil for the front panel is renewed after every run of 25 panels. This ensures the crispest possible lettering. Note that ONLY JAYCAR use the ORIGINAL ETI front panel design. Don't get caught with something you may not like the look of! We use the extra high quality LM394H in the M.C. preamp, and now AT NO EXTRA CHARGE supply gold plated RCA sockets on all inputs, not just the M.C. input. Despite what others may say, their's is not as good as the original BLUEPRINT Preamp. They do not, for example, get special low capacitance screened cable made to Jaycar specs. Just for the pre-amp. (It's made in Australia, not Taiwan). AMONG OTHER FEATURES OF THE BLUEPRINT :-  
- EXTREMELY CLOSE TRACKING TO  
- RIAA EQUALISATION  
- ENGLISH 'LORLIN' LOW NOISE  
- SELECTOR SWITCHES USED  
- LOW NOISE 1% METAL FILM  
- RESISTORS USED  
- TINNED F/GLASS PCB'S  
- ON REGULATOR  
- QUALITY IC SOCKETS PROVIDED  
- SPECIAL REAR PANEL  
- MULTICOLOURED LED  
- DISPLAY (EASIER TO READ  
& BETTER LOOKING)  
- THERMALLOY HEASINK USED

We still have the standard \$245 version of this kit which is better than the other \$245 kits. We don't sell many though - the BLUEPRINT is better value. "BLUEPRINT" ONLY \$275.

FROM \$245  
BLUEPRINT \$275

## SPECIFICATIONS

### Frequency Response

High level input: 15Hz 120kHz, +0 - 1dB  
Low level input: conforms to RIAA equalisation  
+0.2dB (see detail on Phono spec.)  
1kHz <0.003% on all inputs (limit of resolution  
on measuring equipment due to noise limitation)  
High level input, master full, with respect to  
300mV input signal at full output (1.2V)  
> 92dB flat > 100dB A-weighted

### Distortion

MM input, master full, with respect to full  
output (1.2V) at 5mV input, 500 ohm source  
resistance connected > 86dB flat  
> 92dB A-weighted

### S/N noise

MC input, master full, with respect to full  
output (1.2V) and 200mV input signal  
> 71dB flat > 75dB A-weighted

### ETI 478MM Moving Magnet input stage

Gain  
Frequency Response

> 1kHz  
Conforms to RIAA Equalisation +0.2dB

Total Harmonic  
Distortion

<0.001% 1kHz, 10mV RMS input  
e.g. 135mV RMS

Noise

total equivalent input noise, 122mV A, input  
shorted, 216mV flat, input shorted

S/N ratio

1mV 5mV 10mV  
72dB 87dB 92dB

Flat

A weighted 78dB 92dB 98dB

### ETI 478MC Moving coil input stage

Gain  
Frequency Response

24  
7Hz 135kHz +0 - 1dB

Total Harmonic  
Distortion

<0.003% 1kHz, 30mV input

Noise

total equivalent input noise  
83mV flat, input shorted  
42mV A, input shorted  
56mV flat, after RIAA Eq. input shorted  
14mV A, after RIAA Eq. input shorted

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Ph. 2646688 Telex 72293

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\$5-\$9.99 (\$1.20) \$10-\$24.99 (\$2.40)

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\$100 up (\$6.20)

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SEPTEMBER 1ST- OPENING AT CARLINGFORD!!!





The ZX PRINTER  
— designed for use  
with ZX81 and ZX80  
with 8K BASIC ROM.  
Alpha-numerics! Graphics!

**\$190**  
incl. Sales Tax



**\$199**  
COMPLETE

# Sinclair ZX81 PERSONAL COMPUTER

\* excluding mains adaptor

# Sinclair

**COMPLETE WITH BASIC  
MANUAL, LEADS, ONLY \$199**

**16K-BYTE  
RAM PACK \$150**

**Higher specification,  
lower price — how's it done?**

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

The ZX81 comes complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

**New, improved specification**

- Z80 a microprocessor — new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.

- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function — useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.

- Able to drive the new Sinclair printer (not available yet — but coming soon!)
- Advanced 4-chip design, microprocessor, ROM, RAM, plus master chip — unique, custom-built chip replacing 18 ZX80 chips.

**ZX Software Cassettes**

Send for free catalogue of Games, Business, Educational, Junior Education. Encl. S.A.E.

**FREE New Basic ZX81 Manual**

## ORDER FORM: SINCLAIR EQUIPMENT (A'SIA) P/L

86-88 Nicholson St., Abbotsford, Vic. 3067. Ph. (03) 419 3033.

QUANTITY	ITEM	ITEM PRICE	TOTAL
	Ready assembled ZX81 Sinclair Personal Computer including leads, BASIC manual, excluding mains adaptor.	\$199	
	16K-BYTE RAM pack (optional extra)	\$150	
	1.2 Amp Adaptor	\$ 17.50	
	ZX Printer	\$190	

I enclose cheque/Bankcard/Diners Club/Amex

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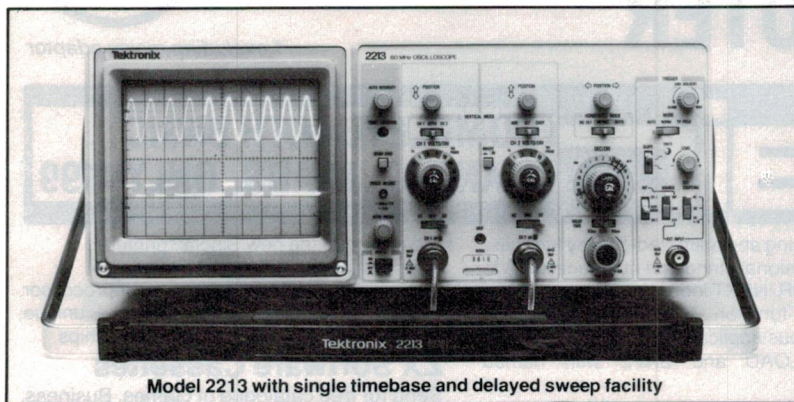
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**R EXCLUSIVE ETI READER OF**

# **TEKTRONIX DUAL-TRACE HIGH PERFORMANCE 60 MHz PORTABLE OSCILLOSCOPES**

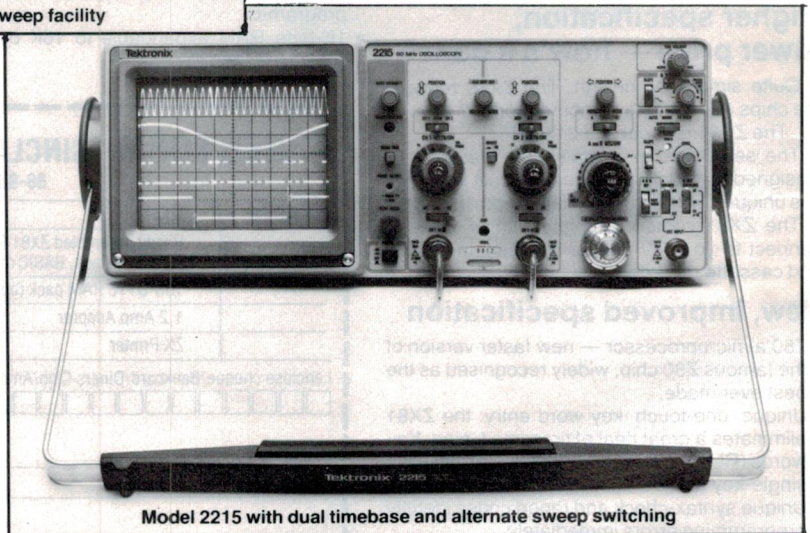
Here is an excellent opportunity to buy a high performance 60 MHz oscilloscope from the world's leading oscilloscope maker at a very special price — exclusive to ETI readers.



Model 2213 with single timebase and delayed sweep facility

## **FEATURES** See review, pages 15 to 18, July issue.

- Tektronix' two-year standard form of warranty.\*
- 8 x 10 cm display, internal graticule
- dc to 60 MHz bandwidth
- 2 mV sensitivity
- 5 ns/div (x10) to 0.5 s/div sweep speed range
- advanced trigger system
- delayed sweep measurements
- multiple vertical display modes
- multiple horizontal display modes
- easy to use
- light weight — 6.1 kg (w/out accessories)
- new x10 probes with IC grabbers included
- a variable trigger hold-off
- TV line and field triggering at any sweep speed
- enhanced auto mode
- Z-axis input (brightness modulation)



Model 2215 with dual timebase and alternate sweep switching

*THROUGH THIS SPECIAL DEAL TEKTRONIX IS OFFERING THE MODELS 2213 AND 2215 PORTABLE OSCILLOSCOPES (REVIEWED LAST MONTH) AT SAVINGS UP TO HUNDREDS OF DOLLARS OFF. ORDERS WILL BE ACCEPTED ONLY WHILE STOCKS LAST AND IN ANY EVENT NOT AFTER 31 OCT. '82. ORDERS MUST BE PLACED BY COMPLETING THE COUPON OPPOSITE.*

**You cannot walk into a Tektronix sales office and buy one of these oscilloscopes at this price — it can only be purchased at this special price through ETI.**

\* The standard "Corporate Warranty Statement" of Tektronix Australia Pty Ltd is available for inspection at any of the offices shown opposite.



# EXCLUSIVE ETI READER OF

## SPECIAL OFFER PRICES

☆ **Model 2213**  
**\$1139 excl. sales tax**  
**\$1322.38 inc. sales tax**  
 ☆ **Model 2215**  
**\$1422 excl. sales tax**  
**\$1650.94 inc. sales tax**

*Both models are supplied as illustrated and come complete with two P6120 x10, 60 MHz probes and instruction manuals. Cover and accessory pouch not included. (Usual cost \$65.)*

Tektronix currently list the 2213 at \$1392 (\$1616.11 inc. tax) and the 2215 at \$1758 (\$2041.00 inc. tax), which includes probes, manuals, cover and pouch.

Anyone purchasing a 2213 or 2215 through this offer may later obtain accessories, but only directly from Tektronix. Tektronix accessories for these oscilloscopes include: cover and accessory pouch (020-0672-00); viewing hood (016-0566-00); C-5C Opt 04 scope camera; Model 200C SCOPE-MOBILE cart; rack adaptor kit (016-0466-00).

## INSPECTION

You can inspect one of these oscilloscopes during office hours at the following places:

<b>Sydney:</b> ETI Offices 15 Boundary St Rushcutters Bay NSW	<b>Melbourne:</b> Murray Publishers Offices 22nd Floor, 150 Lonsdale St Melbourne	<b>Adelaide:</b> Tektronix 128 Gilles St Adelaide (Phone 223-2811)	<b>Brisbane:</b> Tektronix 737 Logan Rd Greenslopes (Phone 394-1155)	<b>Perth:</b> Tektronix 66 Wellington St East Perth (Phone 325-8433)
--	--	--	--	--

## HOW TO ORDER YOUR OSCILLOSCOPE

Fill out the coupon here and enclose a cheque, bank cheque or money order for the amount required made out to TEKTRONIX.

If you are not paying sales tax, please quote your sales tax number on the coupon, where indicated, or for schools, colleges or other educational institutions, enclose a sales tax declaration on your letterhead. The completed coupon, together with your cheque, bank cheque or money order should be sent to:

**TEKTRONIX SCOPE OFFER**  
**c/o ETI, 15 Boundary St**  
**Rushcutters Bay NSW 2011**

**DELIVERY** Tektronix will endeavour to deliver the goods inside four (4) weeks from receipt of payment. Delivery (or acknowledgement of coupon) should occur within two weeks.

Please supply, on the terms outlined in this offer and in the standard "Corporate Warranty Statement" of Tektronix Australia Pty Limited.

..... Model 2213 CRO(s) @ \$1139 each, excl. tax or @ \$1322.38 each, inc. tax.

..... Model 2215 CRO(s) @ \$1422 each, excl. tax or @ \$1650.94 each, inc. tax.

Sales Tax No. .... (if applicable).

I enclose \$ ..... total.

Name .....

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Send completed coupon with cheque or money order to:

TEKTRONIX SCOPE OFFER, c/o ETI, 15 Boundary St, Rushcutters Bay NSW 2011

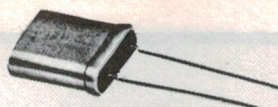
This offer is made by Tektronix Australia Pty Limited (Incorporated in ACT).



Jack O'Donnell

## BANKCARD IETSERVICE-





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3.7598 MHZ XSTAL as used in clock modules, counters etc.

Y 1010 ..... \$1.50 \$3.00

10,000 MHZ XSTAL parallel resonant, low age rate, as used in EA digital frequency counter project and microprocessor projects.

NOW 1/2 PRICE \$4.75

Y 1020 ..... \$9.50

### KEY OPERATED SWITCH



19.5 mm mounting hole required. Supplied with two keys. Hundreds of applications for security type applications.

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NOW ONLY \$5 EACH

### D25 SERIES CONNECTORS

Universal 25 Pin Computer Series

P 0900 Male 25 Pin ..... \$5.50 NOW \$3.95  
P 0901 Female 25 Pin ..... \$5.50 NOW \$4.50  
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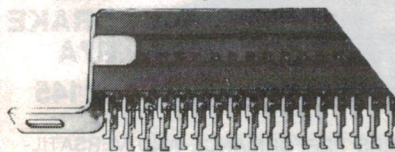


SAVE NEARLY 30%

### .1 INCH PITCH EDGE CONNECTOR

Supplied with mounting feet and polarizing key.

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P 0945 24 Way \$3.60 NOW \$3.00



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Works off 12V car battery. (Comes fitted with lighter plug). AND just as well off 12V AC. Use M2156 Transformer in H 0442 Box and Presto you have a low cost mains isolated iron!

OUR PANIC SELLOUT PRICE \$3.00 ea.

T 2512 ..... \$3.95

### XENON TUBE

As used in strobe projects etc.

S 4050 ..... \$2.95

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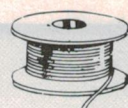
### TRIGGER TRANSFORMER

For S 4050



M 0104 ..... \$95

NOW 60c



### TINNED WIRE

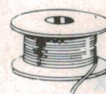
22 gauge  
100 gram Reel

W 0320 ..... ONLY \$2.50

### HOOK UP WIRE BARGAINS

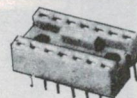
Quality tinned 13/.12mm H/U wire available in 8 colours. On 100m reels.

W 0250 Red  
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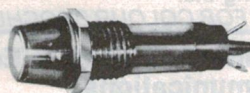
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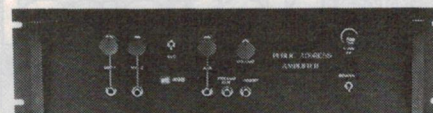
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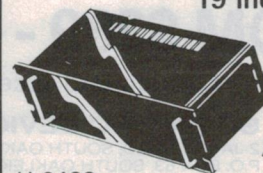
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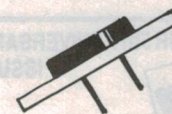
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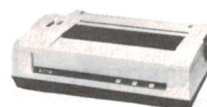
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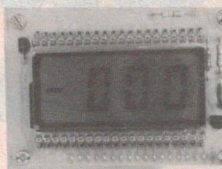
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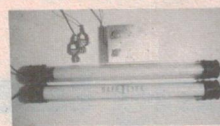
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## THIS MONTH'S KITS



### ETI-161 DIGITAL PANEL METER

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### ETI-1505 FLUORESCENT LIGHT INVERTER

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PCB PRICE	DESCRIPTION	DATE	PRICE
ET 014	4.50 Dual Voltage Power Supply	Dec 71	
ET 043	2.00 Head or Tails	Oct 76	\$3.50
ET 044	1.90 Two Tone Doorbell	Oct 76	\$4.50
ET 047	1.90 Morse Practice Set	Dec 76	\$3.50
ET 048	1.90 Buzz Board	Dec 76	\$3.50
ET 061	2.20 Simple Audio Amp	Oct 76	\$5.50
ET 062	2.50 Simple AM Tuner	Mar 77	\$5.50
ET 063	2.50 Electronic Bongos	Nov 79	\$5.50
ET 065	2.20 Electronic Siren	Dec 79	\$5.50
ET 066	1.90 Temp Alarm	Dec 79	\$4.00
ET 068	2.20 Led Dice	Oct 76	\$5.50
ET 071	2.50 Tape Noise Limiter	Jan 79	
ET 072	1.90 Two Octave Organ	Jan 78	\$5.50
ET 083	1.90 Train Controller	Dec 79	
ET 084	2.50 Car Alarm	Jan 77	\$12.00
ET 085	1.90 Car over Rev Alarm	Oct 79	
ET 130	1.90 Temp/Volts Converter	Feb 76	
ET 132	2.90 Experimentor Power Supply	Feb 77	
ET 134	2.90 R.M.S. Voltmeter	Aug 77	
ET 135	2.50 Digital Panel Meter	Oct 77	
ET 136	2.50 Linear Scale Cap. Meter	Mar 78	
ET 137A	3.90 Frequency Meter Lcd	May 78	
ET 137B	3.90 Audio Oscillator	May 78	
ET 139	1.90 Power Meter	May 78	
ET 147	3.50 Electronic Dummy Load	Oct 80	\$20.00
ET 149	3.50 2 Tone Generator	Jul 80	\$34.00
ET 152	2.90 Capacitance Meter	Feb 80	
ET 157	4.50 Crystal Marker	Oct 81	\$24.50
ET 158	3.50 Low Ohms Meter	Nov 81	\$29.50
ET 159	2.90 10-15V Exp. Scale Voltmeter	Dec 81	\$23.00
ET 245	2.90 White Line Follower	Nov 77	
ET 250	3.50 House Alarm (262)	Aug 80	
ET 255	2.90 Thermometer	Nov 80	
ET 256	2.90 Humidity Meter		\$19.50
ET 257	2.50 Universal Relay Board	May 81	\$12.50
ET 258	2.50 Mini Drill Speed Controller	Jul 81	\$ 8.00
ET 259a	2.50 Versatile Incremental Timer	Jan 82	\$30.00
ET 260	2.60 Photo Lamp Flasher	Dec 79	
ET 261	2.90 Fog Horn	Dec 79	
ET 262	2.90 Intercom	Dec 79	
ET 263	2.90 Simple Egg Timer	Dec 79	
ET 264	2.90 Simple Siren	Mar 80	
ET 316	3.50 Transistor Assisted Ignition	May 77	
ET 317	3.50 Car Rev Monitor	Jul 77	
ET 324	2.50 Led Tacho	Aug 80	
ET 325	2.50 Car Auto Electric Probe		
ET 326	2.50 Exp. Scale Led Voltmeter	Spt 80	\$12.50
ET 327	2.90 Turn/Hazard Indicator	Oct 80	\$22.00
ET 328	2.90 Led Oil Temp Meter	Jan 81	\$15.50
ET 329	2.50 Exp. Scale Vehicle Ammeter	Feb 81	\$19.00
ET 330	3.90 Car Alarm	Jul 81	\$27.50
ET 332	2.90 Electronic Stethoscope	Aug 81	\$34.00
ET 333	3.50 Reversing Alarm	Jan 82	\$16.00
ET 363	3.50 Overload Indicator		
ET 417	2.90 Led Level Meter	Aug 73	
ET 440	8.50 25 Watt Stereo AMP	Mar 75	\$11.00
ET 445	2.20 General Purpose Preamp	Jul 76	\$8.00
ET 446	3.50 Stereo Limiter	Jul 76	
ET 449	2.90 Mike Amplifier	May 77	
ET 450A	3.50 Bucket Brigade	Dec 77	
ET 450B	3.20 Bucket Brigade	Dec 77	
ET 452	2.90 Guitar Practice Amplifier	Jan 80	
ET 453	2.90 AMP Class B. Gen Purpose	Apr 80	
ET 454	3.50 Fuzz Box	Apr 80	
ET 455	3.90 Loud Speaker Protector	Mar 80	\$25.50
ET 457	2.90 Scratch & Rumble Filter	Spt 80	
ET 458	4.90 Led Level Meter	Jan 81	\$27.00
ET 459A	3.50 300W AMP Module	Feb 80	\$83.00
ET 466	6.90 4 Input Mike Preamp	Jul 80	\$27.50
ET 470	2.90 60 Watt Amp Module Series 4000	TPV 6	\$26.00
ET 471	1.90 Audio Preamp Series 4000	TPV 6	\$45.00
ET 472	2.90 Power Supply For Series 4000	TPV 6	\$54.00
ET 473	5.90 Moving Coil Preamp Series 4000	TPV 6	
ET 474	2.90 Interface 60W Amp	Jan 80	
ET 475	4.90 AM Tuner	Spt 80	\$80.00
ET 476	6.90 Series 3000 AMP 25W Stereo	Nov 80	\$84.00
ET 477			
<b>SERIES 5000 POWER AMP COMPLETE KIT</b>			
ET 478MB	15.00 Series 5000 Preamp Main Board	Oct 81	
ET 478MC	3.90 Moving Coil Preamp (5000)	Spt 81	\$24.50
ET 478NM	3.90 Moving Magnet Preamp (5000)	Spt 81	\$18.50
ET 478SA	2.50 Series 5000 Preamp Switch Bnd	Oct 81	
ET 478SB	1.90 Series 5000 Preamp Switch Bnd	Oct 81	
ET 478SC	1.90 Series 5000 Preamp Switch Bnd	Oct 81	
ET 478SD	1.90 Series 5000 Preamp Switch Bnd	Oct 81	
<b>SERIES 5000 PREAMP COMPLETE KIT</b>			
ET 480	2.90 50 Watt Amp Module	30 Ap	\$17.50
ET 480	2.90 100 Watt Amp Module	30 Ap	\$22.00
ET 480PS	2.90 50-100 AMP Module Pwr Supply	30 Ap	\$22.00
ET 481M	2.75 Hi-Power P.A./Guitar Amp Mod.	30 Ap	
ET 481PS	4.90 12V / 100 P.A. Inverter	30 Ap	
ET 483	3.90 Sound Level Meter	Feb 78	
ET 484	4.90 Expander Compressor	Jul 77	
ET 485	4.50 Graphic Equaliser	Jan 77	
ET 486	3.90 Howl Round S-buzzer	Nov 77	
ET 489A	3.50 Audio Spectrum Analyser No2	Apr 78	
ET 489B	3.50 Audio Spectrum Analyser No2	Apr 78	
ET 496	2.90 Series 4000-1 Speaker Kit	Feb 80	\$820.00
ET 528	2.90 Intruder Alarm	Jan 75	
ET 539	2.90 Touch Switch	Mar 76	
ET 541	2.90 Train Controller	May 76	
ET 547	3.50 Telephone Bell Extension	Jan 77	
ET 549A	2.90 Metal Detector	May 77	
ET 560	1.90 240V Mains Locator	May 80	
ET 561	2.90 Metal Detector	Mar 80	\$34.00
ET 562	3.90 Geiger Counter	Apr 80	
ET 563	3.50 Nicad Fast Charger	Jul 80	
ET 566A	2.90 Pipe & Cable Locator	Apr 80	\$54.00
ET 566B	3.90 Pipe & Cable Locator	Apr 80	
ET 567	3.50 Core Balance Relay	Apr 81	\$42.00
ET 568	2.90 Photo Flash Trigger	Oct 80	\$25.00
ET 570A	2.90 Infrared 'Trip' Relay TX	Jan 82	
ET 570B	2.90 Infrared 'Trip' Relay RX	Jan 82	
ET 572	4.90 Digital PH Meter	Dec 80	\$80.00
ET 573	3.50 Universal Timer	Oct 79	
ET 576	5.90 Electromyogram	TPV 6	\$80.00
ET 577	3.50 General Purpose Power Supply	TPV 6	\$30.00
ET 578	2.90 Simple Nicad Charger	Jan 80	
ET 581	2.50 15V Dual Power Supply	Jan 76	\$9.50
ET 583	2.90 Marine Gas Alarm	Aug 77	
ET 585R	1.90 Ultrasonic Receiver	TPV 6	\$16.00
ET 585T	1.90 Ultrasonic Transmitter	TPV 6	\$9.50
ET 591A	2.90 Up/Down Digit Counter	Jul 78	
ET 591B	2.90 Up/Down Digit Counter	Jul 78	
ET 596	2.90 White Noise Generator	Nov 81	\$8.00
ET 598	2.50 Touch Switch	Feb 81	\$10.00
ET 599B	2.50 Infra Red Remote Control TX	May 80	
ET 599B	2.50 Infra Red Remote Control	May 80	
ET 599C	2.50 Infra Red Remote Control	May 80	
ET 599D	2.20 IR Remote Control Power Supply	Aug 77	
ET 603	4.90 Music Synthesizer Sequencer	Spt 77	
ET 604	6.04 Metronome	Nov 79	
ET 606	3.90 Electronic Tuning Fork	Nov 79	
ET 607A	2.90 Sound Effects Generator	Aug 81	
ET 607m	2.90 Sound Effects Generator	Aug 81	
ET 607m	2.90 Sound Effects Generator	Aug 81	
ET 631-2	7.50 Keyboard Encoder	Apr 77	
ET 635	3.90 Train Steam Whistle	Apr 81	
ET 636	16.90 7 Slot S100 Mother Board	May 80	
ET 637	4.90 Cassette Interface	Jan 78	
ET 638A	4.90 Eeprom Programmer	Jul 78	\$148.00
ET 640	65.00 Memory Mapped VDU		
ET 650A	4.50 Stac Timer	Nov 78	
ET 650B	4.50 Stac Timer	Nov 78	
ET 650C	4.50 Stac Timer	Nov 78	
ET 660	19.00 Learners Microcomputer	Oct 81	\$90.00
Key Set (18) To Suit ET660			
Colour Option Kit To Suit 660			
ET 682	69.00 Versatile Eeprom Card	Mar 81	\$30.00
ET 708	2.90 FM Tuner add on	Mar 76	\$14.00
ET 713	4.90 Crosshatch Generator	Spt 77	\$115.00
ET 717	4.50 R.F. Amp 70W 6/10 Meter	May 78	
ET 726	3.50 UHF TV Masthead amp	Feb 80	
ET 729	3.90 UHF TV Converter	Apr 81	\$36.00
ET 730	3.90 Teletype Modulator	May 81	\$37.50
ET 731	4.50 UHF to VHF Converter	Oct 79	
ET 735	3.90 Video Mod. To Suit 660 Micros	May 81	\$14.00
ET 760	2.90 Slot Car Controller	Spt 81	\$17.00
ET 824	2.90 Slot Car Power Supply	Dec 81	\$16.00
ET 825	5.90 Slot Car Controller	Dec 81	\$70.00
ET 1501A	2.50 Without Case	Dec 81	\$55.00
ET 1501B	2.50 Negative Ion Generator	Apr 81	\$30.00
ET 1501C	1.50 Negative Ion Generator	Apr 81	
ET 1503	3.90 Battery Charger	Aug 81	
EA			
Dream 6800	12.50		\$100.00
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HEX Keypad 16 keys			\$25.50
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80G6	5.90		
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80AD12	3.00		
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80TM8A	5.90		
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81DC3A	9.50		
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81SD9	4.20		
81P19			
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81SS11	4.90		
81GA9	3.90		
81UC8			
81MC7	9.50		
81SW7			
81SM7	2.90		
81VM2	2.90		
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81HB4B	7.50		
81MA4	2.50		
81RC4A	3.50		
81RC4B	2.50		
81RC4C	2.75		
81SP5	2.50		
81OR7	9.50		
81CH12	3.50		
81fm10a	4.90		
81fm0a	4.90		
81fm0b	3.50		
81D12	3.90		
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82ep1	7.90		
81mill	2.50		
81wd12a	2.50		
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HE102	2.50		
HE103			
HE104	\$2.20		
HE105	\$2.50		
HE106	2.90		
HE107	3.50		



# The Australia Telescope

## Expanding the frontiers of knowledge

Australia will have the most versatile radio telescope array in the world — provided the Australia Telescope proposal now before the Commonwealth Government is approved in the 1982 Federal budget. If construction can start in 1982, the Australia Telescope will come into operation in 1988, to give the nation a flying scientific start into its third century.

THE TWO FIELDS of scientific endeavour in which Australia is internationally renowned are: immunology — the study of the immunity from disease and the conditions governing it; and radio astronomy — the exploration of the universe by means of radio telescopes.

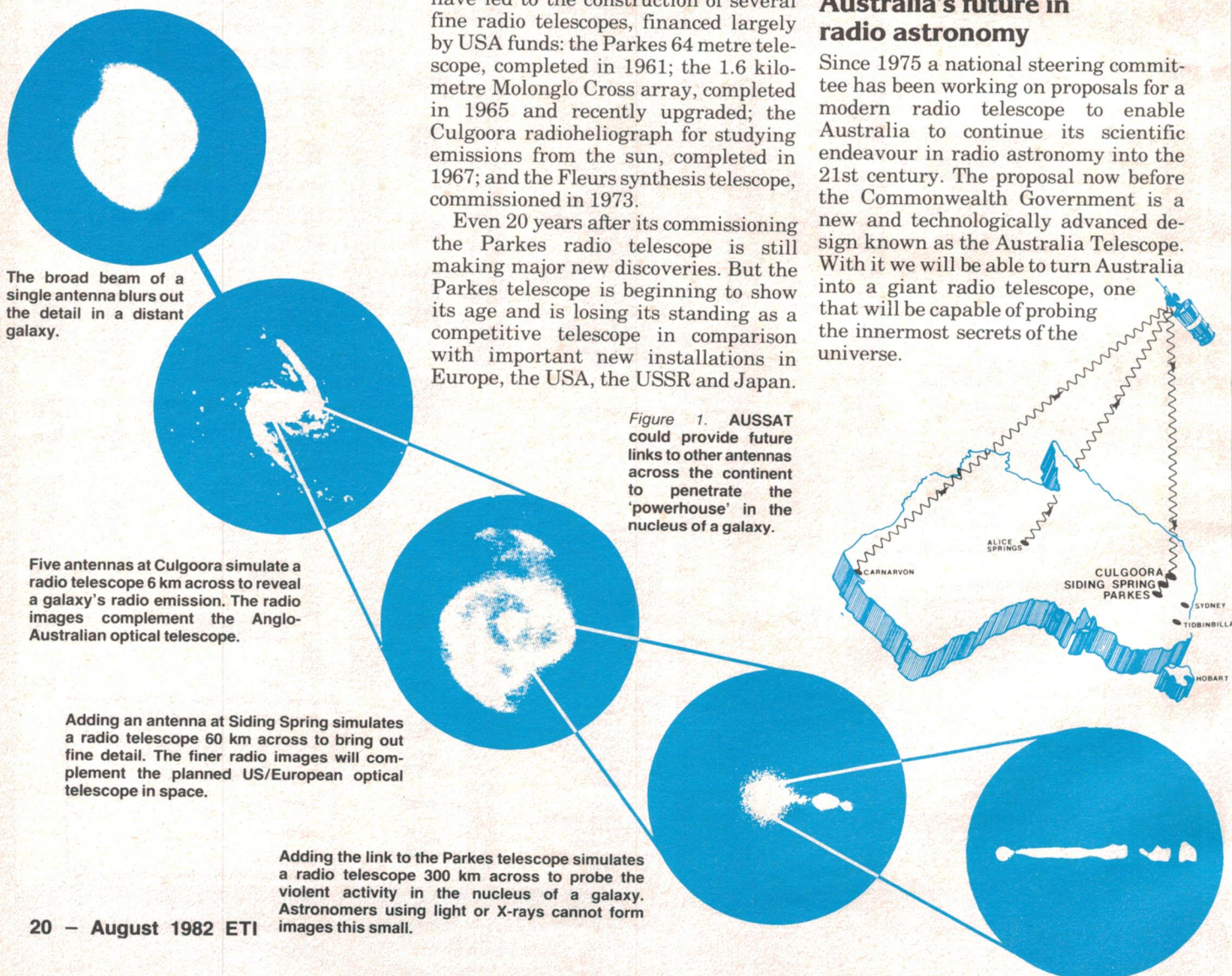
The construction of innovative radio telescopes and their role in unravelling the secrets of the universe were pioneered by Australian scientists following their wartime effort in the development of radar. The outstanding achievements of the scientists have brought great prestige to Australia and have led to the construction of several fine radio telescopes, financed largely by USA funds: the Parkes 64 metre telescope, completed in 1961; the 1.6 kilometre Molonglo Cross array, completed in 1965 and recently upgraded; the Culgoora radioheliograph for studying emissions from the sun, completed in 1967; and the Fleurs synthesis telescope, commissioned in 1973.

Even 20 years after its commissioning the Parkes radio telescope is still making major new discoveries. But the Parkes telescope is beginning to show its age and is losing its standing as a competitive telescope in comparison with important new installations in Europe, the USA, the USSR and Japan.

By 1990 the types of observations needed in radio astronomy will be beyond the capabilities of the Parkes telescope and also those of the Molonglo and Fleurs synthesis telescopes. The radioheliograph at Culgoora is already scheduled to cease operations in 1984.

### Australia's future in radio astronomy

Since 1975 a national steering committee has been working on proposals for a modern radio telescope to enable Australia to continue its scientific endeavour in radio astronomy into the 21st century. The proposal now before the Commonwealth Government is a new and technologically advanced design known as the Australia Telescope. With it we will be able to turn Australia into a giant radio telescope, one that will be capable of probing the innermost secrets of the universe.





Provided funding is approved in 1982, the Australia Telescope will come into operation in 1988. Accordingly, the proposal has been put forward for consideration as a bicentennial project. This most significant and lasting project will pay tribute to our past accomplishments in science and ensure the continuation of this fine tradition by a new generation of Australian scientists.

## The concept

The Australia Telescope will consist of three main elements. One would be a linear array of five 22 metre dishes at Culgoora, near Narrabri in New South Wales. Another 22 metre dish would be located at Siding Spring near Coonabarabran, the site of Australian and British optical telescopes, while the third element would be the existing 64 metre dish at Parkes.

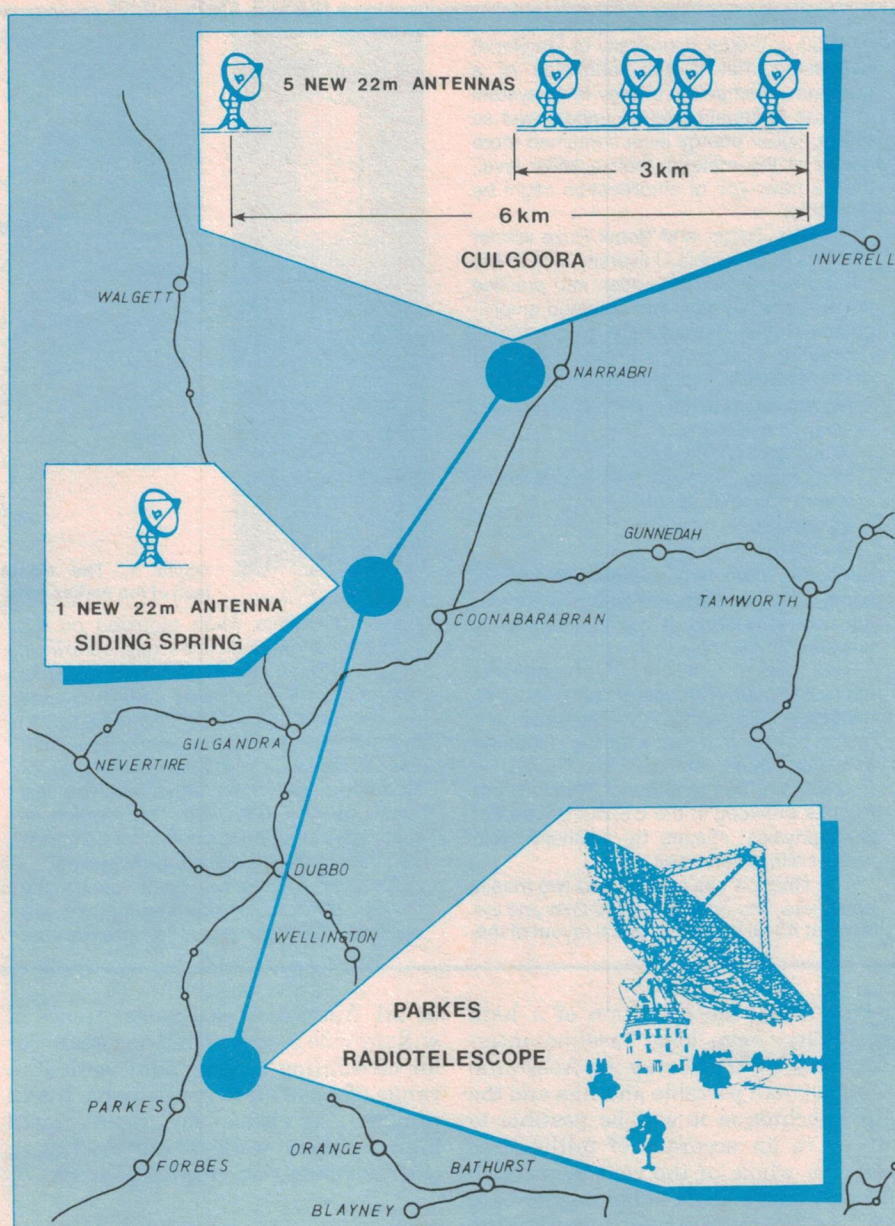
The array at Culgoora alone will simulate a telescope six kilometres in diameter; this array will allow mapping of the broader features of radio sources and investigations of spectral line emissions from giant molecular clouds in our galaxy. By linking the Culgoora array to the Parkes and Siding Spring dishes, the proposed telescope would form an array equivalent to a single dish 300 kilometres across. As such it will be the most versatile synthesis telescope in the world and will have the potential to make major discoveries well into the 21st century.

But the possibilities for the Australia Telescope do not end with the proposed array itself. The Australia Telescope array, which would be the first of its type in the southern hemisphere, could be linked, via satellite, to span the entire 3000 kilometres of the Australian continent. It would link radio telescopes in Culgoora, Siding Spring, Parkes, Fleurs near Sydney, Tidbinbilla, Hobart, Alice Springs and Carnarvon, as shown in Figure 1.

With this enlarged array, Australia would have the highest sensitivity high resolution telescope in the world, an array which will recognise details 1000 times smaller than even the most powerful single telescopes can detect.

## What makes the Australia Telescope unique?

By linking radio antennas across the country via satellite and ground links, the Australia Telescope will be able to see finer details than any optical telescope, either ground-based or spaceborne. A unique and fundamental feature of the telescope will be its ability to 'see' the radio sky on all angular



Locations of the three basic elements of the Australia Telescope.

scales; that is to have an effective zoom ratio of 10 000 to 1.

By itself, the 6 km array at Culgoora will be able to form radio images with detail matching the one second of arc image size of the Anglo-Australian optical telescope at Siding Spring. With the array stretching from Culgoora to Parkes, we will be able to complement the 0.1 second of arc images of the US/European Space Telescope due for launching in 1986. Higher resolutions still, to one thousandth of a second of arc, are available at radio wavelengths by linking radio dishes across the continent; this level of resolution is not obtainable at optical, X-ray or other wavelengths.

In everyday terms, such high resolution is equivalent to a person being able to see a ten cent coin in Sydney whilst stationed in Melbourne.

But there are other aspects which make the Australia Telescope unique. It will be the only instrument designed specifically for spectral line observations.

It will be the only large array in the southern hemisphere. Other existing and proposed arrays of radio telescopes are all in the northern hemisphere. They reveal very fine details of radio sources visible from the northern latitudes. However, many of the most interesting radio sources lie too far south in the skies for these telescopes. The Australia Telescope array in the southern hemisphere is ideally located to explore these sources.

The Australia Telescope will also have some very down-to-earth applications as well. The proposal opens up a whole new range of possibilities for the geophysics and geodetic communities. ▶



## MASER AMPLIFIERS

In 1953 J. Weber (University of Maryland) suggested that if the population of a quantum mechanical energy-level system in some material could be unbalanced so that a higher energy level contained more atoms of the material than a lower level, then a new type of amplification might be available.

Gordon, Zeiger and Nobel Prize winner Townes at Columbia University, NY, in the following year put the notion into practice using ammonia gas, and obtained amplification at the characteristic frequency of ammonia, 23 870 MHz. They called the device a MASER—the word is an acronym:

Microwave (because of the radio band where it occurred)  
Amplification by  
Stimulated (because the natural equilibrium has to be upset)  
Emission of  
Radiation

Later the more famous acronym LASER came along, in which this type of amplification was produced at the frequencies or wavelength of visible light.

The maser amplifier is of particular interest to radio astronomers because of its extremely high sensitivity. The price one has to pay for this characteristic is that the amplifier must be cooled to 4.5 K (−268.5°C) for it to operate. This environment is provided in the CSIRO Division of Radiophysics' masers by a closed-cycle helium refrigeration unit.

The Division has constructed two maser amplifiers, one operating at 22 GHz and the other at 43 GHz. The physical layout of the

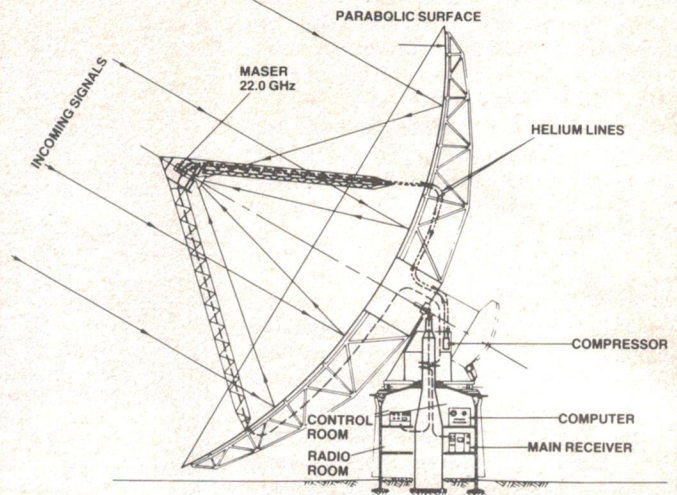
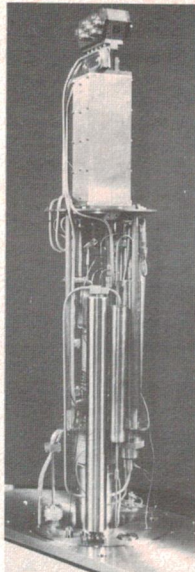


Figure 1. The maser amplifier will be located behind the prime focus feed of the Parkes dish.

maser amplifiers when mounted on the Parkes 64 metre radiotelescope is shown in Figure 1. The maser amplifier is situated at the focus of the telescope and is mounted on the cold station of the refrigeration system. High-pressure helium gas is supplied to the focus from a helium compressor located in the main structure. The low pressure gas from the cold station is returned to the input side of the compressor, thus forming a closed-cycle system.

Another interesting point about the Division's maser amplifiers is the use of a superconducting magnet to provide the

necessary magnetic field for the maser. As the wire used in the electromagnet becomes superconducting (i.e. has no resistance) at low temperature (less than 10 K), once the field is established in the magnet the external source of energy (for example, a power supply) may be removed with very little effect on the magnetic field. It has been estimated that it would take approximately 500 years till the field in the magnet decayed to about 0.7 of its original value.

J.W. Brooks  
CSIRO Division of Radiophysics

It will allow the operation of a high sensitivity, very long baseline interferometry (VLBI) array in Australia. Using a small portable antenna and the VLBI technique it will be possible to survey to an accuracy of millimetres over the whole of the continent. Such measurements will enable scientists to see how far and in what direction the plates of the Earth's crust are moving. The movement of these plates is believed to be a crucial factor in the causing of earthquakes. Knowledge of fault lines associated with the movement of plates is useful also for mineral and petroleum exploration because deposits often occur along fault lines in the Earth's crust.

### Australian involvement

The Australia Telescope is a totally Australian project with an Australian content in excess of 80%. It draws on Australian astronomy expertise, which is acknowledged world-wide as being at the forefront in all relevant areas. This is the same sort of expertise that attracted, in different circumstances, substantial overseas funding for previous major telescopes in Australia.

The Australia Telescope is to be operated as a national facility available

to all Australian scientists. Hence it will provide stimulus and opportunities for continuing development work in a range of Australian institutions. It will provide the basis for sophisticated higher degree work at universities in both astronomy and technical areas.

### Cost estimates

The rate of expenditure for the six-year construction period of the Australia Telescope is shown in Figure 2. Antenna costs, based on the design study by the Sydney consulting engineers Macdonald, Wagner and Priddle, account for almost half the total cost of \$25 million.

In the 1982/83 financial year only \$820 000 is required to commence the project.

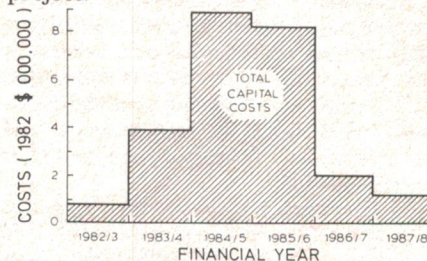


Figure 2. Expenditure rate over period of construction.

### Technological innovation

The Australia Telescope project is one of great scientific merit and technological innovation. As with past advances in radio astronomy, major technological spin-offs relevant to Australian industry will result. Much of the skill and expertise developed will be directly applicable to the design and construction of domestic satellite reception and transmission facilities. Such skills will give local industry a stake in the very important telecommunications market.

CSIRO designs have already provided substantial benefits to the Overseas Telecommunications Commission (OTC) for its ground stations at Moree and Carnarvon.

Work on the image processing capabilities of the Australia Telescope will be of direct relevance to biomedical and industrial applications.

The major design studies which form the basis of the proposal are:

#### Antennae

Very high performance-to-cost ratio has been achieved in the antenna design by Macdonald, Wagner and Priddle in association with Ir B.G. Hooghoudt, and new ways of achieving precision dish surfaces at low cost have been devised.



The expertise will allow efficient ground stations for satellite communications to be designed and built in Australia.

### Antenna Feeds

The antenna feeds for the Australia Telescope will be ultra-wideband and will allow simultaneous multi-frequency observations. The 'polarisation purity' of such feeds, achieved by engineers of the CSIRO Division of Radiophysics, has been crucial for developments in satellite communication. New ideas in feed design for the Australia Telescope have been used to build new feeds for the OTC dish at Moree, so saving OTC some \$4 million.

### Cryogenic Receivers

CSIRO has a major centre of expertise in low-noise receiver and cryogenic technology, thus assuring high sensitivity for the Australia Telescope.

### Satellite Distribution of Time and Frequency

The Australia Telescope will pioneer the use of satellites for the distribution of precision time and frequency references for local oscillator synchronisation.

### Data Transmission using Optical Fibres

The Australia Telescope will employ



Flared corrugated horns, developed by the CSIRO Radiophysics Division, improve radiation pattern symmetry and provide low cross-polarisation with dish antennas — an important requirement in making accurate observations.

high-speed digital techniques to transmit information from the antennae to the central control area. Optical fibres and higher-speed links than those used in current practice will be required.

### Very Large-Scale Integrated Circuits

Specific new VLSI circuits have been designed for the correlation system and

for the signal processing and display systems for the Australia Telescope.

### Image Processing

The Australia Telescope will use unique image processors and display systems of Australian invention to provide better facilities and faster turn-around in processing of images. ►

## THE LIFE CYCLE OF A STAR

A star can exist more or less unchanged for millions of years; a long time compared with the age of our civilization — a short time when compared to the age of the universe.

We can say that there have been many generations of stars since the universe began, and each new generation enriches the universe with heavy elements produced in the nuclear furnace that powers each star.

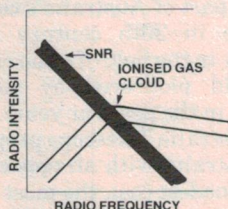
In general a star begins to die when all the hydrogen in its core has converted to helium. If the nuclear reactions in the core cease, then radiation pressure no longer prevents the star from collapsing under its own gravity. After collapse, new nuclear reactions can take place which can blow the star out to a diameter larger than that of the entire solar system. It is then a red giant.

If the mass of the star is at least four times the mass of the sun the collapse will trigger violent nuclear reactions which produce heavy elements in the outer shells of the star. The reaction releases an immense quantity of energy, which in turn blows the outer shells of the star far out into interstellar space, where they become visible for thousands of years as a supernova remnant. The core of the star undergoes simultaneous contraction and compaction, reaching incredible densities of greater than 1000 kg per cubic centimetre. Depending on the initial mass of the star, a white-dwarf star, a neutron star or a black hole is thus formed. A neutron star so formed that spins while rotating is called a pulsar.

The supernova remnant will expand and

become fainter and fainter until after maybe 100 000 years it is lost amongst the interstellar gas, so enriching this gas with its heavy elements.

Finally some of the gas may coagulate, due to gravitational attraction, to then form a new star — a star richer in heavy elements than those of a generation before. It is generally thought that the atoms of all of us have been through many such events. We are indeed 'children of the stars'.



### RADIO EMISSION

A supernova (SNR) expands violently at velocities of up to 12 000 kilometres per second (one Earth diameter every second!). It pushes the surrounding interstellar gas and magnetic field along like a giant snowplough to form a spherical shell around the site of the explosion.

The high energy electrons in this shell interact with the magnetic fields to produce intense radio emission by the synchrotron process. A supernova remnant is brighter around the edges because we see a greater depth of material through the edges of a hollow sphere.

Supernova remnants are generally fairly dim at visual wavelengths and are difficult

to distinguish from the more abundant galactic ionised-hydrogen nebula regions. On the other hand, radio emission from supernova remnants has a characteristic non-thermal spectrum and it usually exhibits relatively strong polarisation effects. Because of this, almost all the known supernova remnants were found from radio searches. In fact, deep optical photographs reveal optical features in less than one quarter of the 125 radio SNRs known in our galaxy.

Supernova remnants are also powerful X-ray sources; however, because our atmosphere absorbs X-rays, the observations of the X-ray emission have to be made from rockets and satellites.

Members of the CSIRO Division of Radiophysics laboratory have been major contributors in this field of astronomical study. Most of the known SNRs were discovered with the Parkes radiotelescope, and our studies of the structure and polarisation of these objects have provided us with an insight into the evolution of this class of nebula.

D.K. Milne,  
CSIRO Division of Radiophysics

### A FEW EXPLOSIONS

1 stick of dynamite	≈ 100 000 bursting toy balloons
1 atomic bomb (Hiroshima)	≈ 10 000 000 sticks of dynamite
1 hydrogen bomb (10 megaton)	≈ 500 atomic bombs
1 supernova explosion	≈ 10 000 000 000 000 000 000 000 000 000 hydrogen bombs!



## Exploring the universe with the Australia Telescope

Important exploratory astrophysical projects await the Australia Telescope at the end of this decade. Many of these projects arise because of our privileged position in the southern sky.

Some of the most interesting radio galaxies will be within the field of view of the Australia Telescope. At present astronomers have only a limited ability to probe the critical central regions of the southern radio galaxy Centaurus A. This galaxy is closer than any other radio galaxy and offers unparalleled opportunities for studying the energy source in such luminous objects. With the Australia Telescope such galaxies will be studied in detail.

The centre of our own galaxy passes almost overhead in northern New South Wales and thus this area is ideally situated as a base for detailed studies of the galaxy. The Australia Telescope will have unrivalled power to investigate the spectral-line emission from giant molecular clouds in our galaxy. The richest of these clouds, which are the birthplace of stars, lie in the southern hemisphere.

The telescope will permit detailed studies of the structure and dynamics of distant galaxies. The nearest galaxies — the Magellanic Clouds — are only visible from the southern hemisphere and provide unique opportunities for research.

Another very important research area in astronomy is that related to the major discrepancy between the apparent birthrate of supernova remnants and pulsars — the two products of a supernova explosion. Such objects can best be studied in the southern hemisphere. Scientists from the CSIRO Division of Radiophysics and the University of Tasmania have recently discovered pulsars in the Magellanic Clouds. The Einstein orbiting X-ray observatory has discovered 80 possible new supernova remnants in the Clouds. Initial radio observations of these sources being made with the Molonglo telescope will lay the basis for a major program with the Australia Telescope.

The Australia Telescope is an essential tool in the study of the following:

- Active galactic nuclei and quasars
- Faster-than-light motions
- Extragalactic astrometry
- The nucleus of our own galaxy
- Violent galactic stars — possible black holes
- Interstellar chemistry
- Maser sources — stars in the making
- Proper motions within our galaxy for radio stars and pulsars
- Compact ionised hydrogen regions

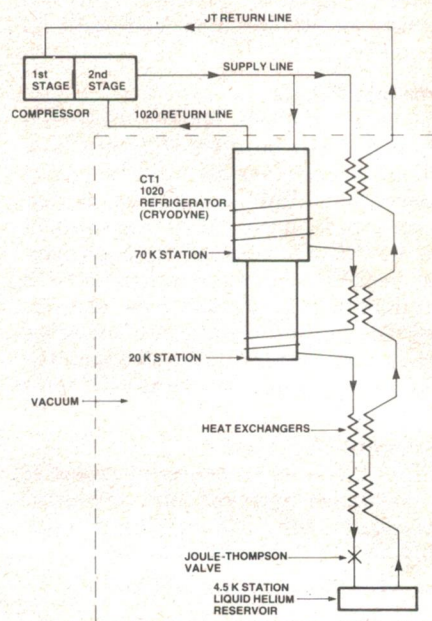
## CRYOGENIC TECHNIQUES

By 'cryogenic temperatures' we mean those temperatures at which common gases such as oxygen liquefy. They are extremely low — in general below 123 K ( $-150^{\circ}\text{C}$ ). Measurements are made in the absolute scale where 0 Kelvins or 0 K (absolute zero) is equivalent to  $-273.2^{\circ}\text{C}$ .

The first systematic investigation of low-temperature problems and gas liquefaction was made by Faraday in 1823. Cryogenics really came of age when the two most stubbornly gaseous of all the elements were finally liquefied: hydrogen (boiling point  $\approx 20\text{ K}$ ) by James Dewar in 1898 and helium (boiling point 4.2 K) by Kamerlingh Onnes in 1908.

Extremely low temperatures are essential in achieving high performance in radio astronomy receivers. The CSIRO Division of Radiophysics uses two types of refrigerator in its research program. Both have to be insulated from their surroundings by a vacuum. The vacuum container is called a dewar, which is an elaborate version of the well-known thermos flask. The first type is called a *cryodyne*, a commercially available refrigerator which maintains equipment dissipating 3 watts of heat at a minimum temperature of 15 K ( $-258^{\circ}\text{C}$ ). Four or five cryodynes are constantly in use in radio astronomy research.

The second type is far more complex. The cryodyne-type unit is used in the initial stages, but then a series of devices called heat exchangers and finally a Joule-Thomson valve achieve a minimum temperature of 4.5 K. (The Joule-Thomson effect is the fall in temperature of a gas when it expands without doing external work.) This



**SCHEMATIC DIAGRAM OF RADIOPHYSICS DIVISION'S 4.5 K REFRIGERATION SYSTEM**

temperature is achieved against a heat dissipation of the equipment to be cooled of about 3 watts. The system produces 8 litres of liquid helium per hour at its cold (4.5 K) station. Two such refrigerators have been developed and constructed in the Division's laboratory.

The accompanying figure is a schematic representation of the unit.

**B. Wilcockson,  
CSIRO Division of Radiophysics**

*This article was prepared with the grateful assistance of the CSIRO, Division of Radiophysics.*

## 1982 — year of decision

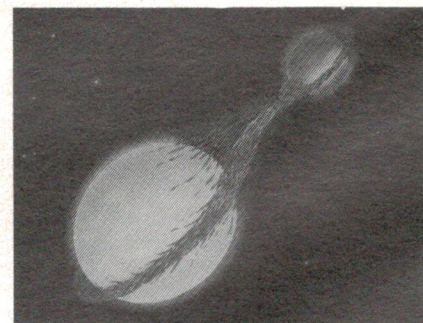
The Australia Telescope has been conceived as part of Australia's continuing vital role in 20th century scientific endeavour in the field of radio astronomy — a field pioneered by Australian scientists in the postwar years.

The Australia Telescope proposal provides Australia with an opportunity to build, at modest cost, the most versatile radio telescope in the world. With it, Australian astronomers can look forward to solving some of the most perplexing problems in astronomy today; without it, one of Australia's most eminent fields of science will die.

1982 is the year of decision for radio astronomy in Australia. If the Australia Telescope is not funded, we are clearly left in a situation where the present radio telescopes will run down over five to seven years. A decision not to fund the Australia Telescope will be seen by the Australian and the world scientific community as a policy decision to discontinue radio astronomy in Australia.

Alternatively, if a start on the

Australia Telescope can be made in 1982, the telescope will come into operation in 1988, Australia's Bicentennial Year. It would be a scientifically and technologically demanding project which would symbolise our past achievements in science and, more importantly, ensure the continuation of this outstanding tradition by a new generation of Australians.

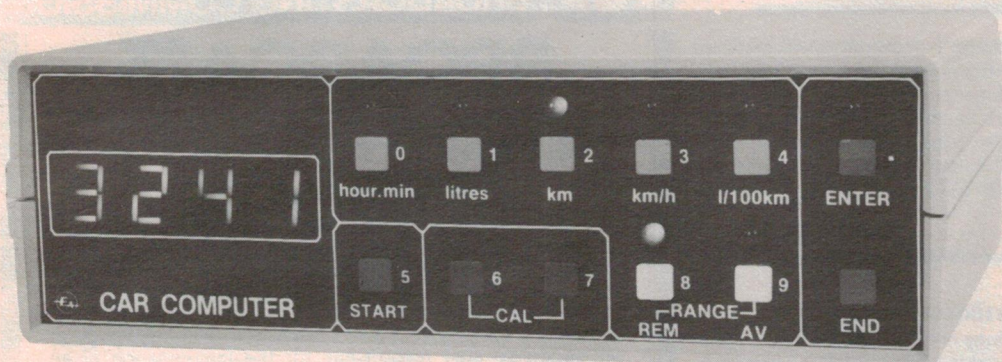


**Do black holes swallow stars?** The Circinus X-1 star system may be an example. This artist's impression shows the dense, compact star 'sucking' matter from a supergiant (lower left). The scale is very distorted — the compact star may only be 10 km in diameter.



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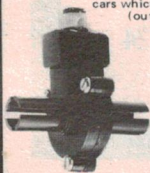
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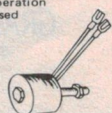
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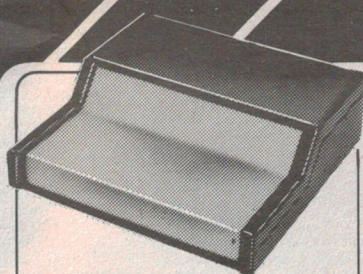
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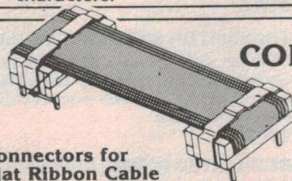
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40 Way	2.86/M

## ELECTRICAL INTERFERENCE UPSETTING YOUR CIRCUITS?

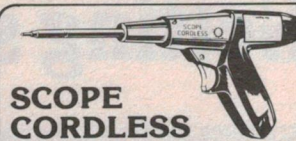


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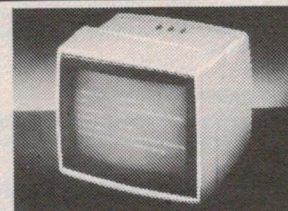


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REGARDS,

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Peter Vernon, Electronics Australia June '82

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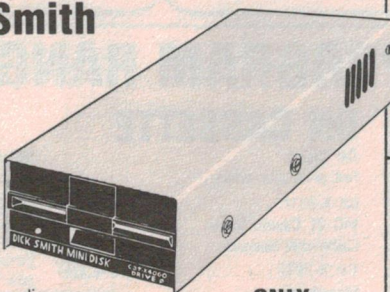
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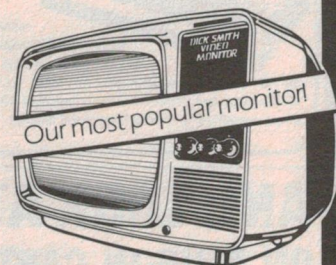
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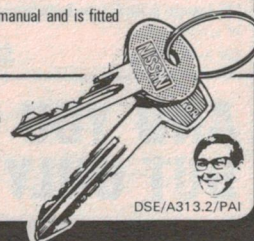


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DSE/A313.2/PAI



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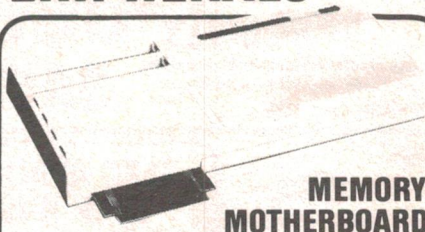
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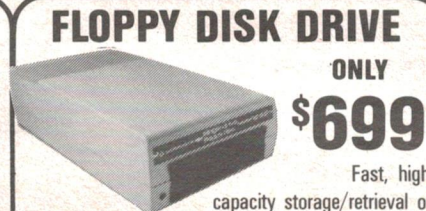
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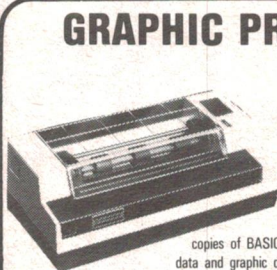


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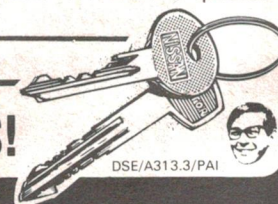
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Some of the world's leading computer manufacturers are now producing CP/M based systems to utilise the vast range of existing software. The only problems for you are 1): Some of the CP/M-based systems are not yet available in Australia, and 2): Some of them may cost up to, and over, \$5,000! So why not check out ...

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Soft sectored disk driver and proportional print driver to be used with the FDS and the word processor ROM PAC

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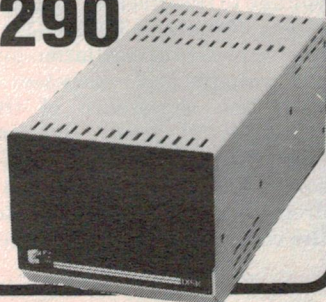
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# Fluorescent light inverter for 12 V battery operation

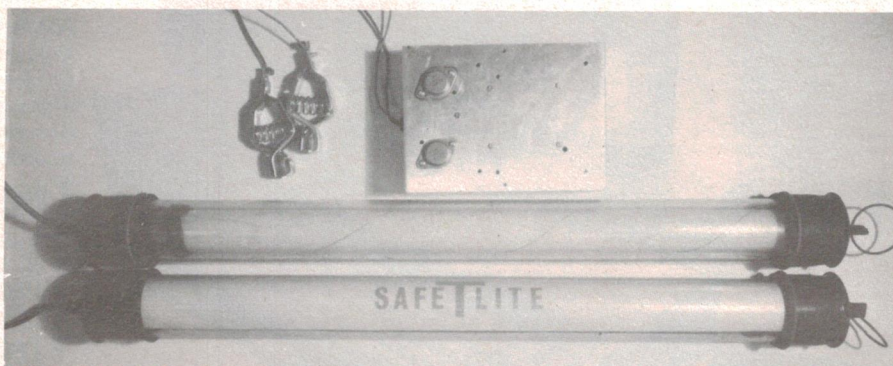
This inverter will drive two 20 W, one 40 W or one 20 W fluorescent tube from a 12 V battery. Light output is some three times that of an equivalent power incandescent globe and efficiency is very high.

**David Tilbrook**

WE FIRST published a fluorescent inverter in the November 1972 issue of ETI. It was a self-oscillating circuit, running at around 2 kHz, and was intended for use with a 20 W fluorescent tube and a 12 V battery. The circuit worked well, and countless numbers have been built over the years. The only disadvantage is the 2 kHz running frequency, which generates an audible tone that can be difficult to silence. Having decided to publish a new design, the main priority was to develop a circuit that would run above 20 kHz, making the inverter totally silent. However, this proved to be a much more difficult task than was first expected, and most of the initial prototypes failed miserably.

The main problems associated with running above 20 kHz are caused by losses in the cores and switching transistors, causing excessive heating and inefficiency. The circuit finally developed overcame these problems with the help of some cores from Philips that exhibit very low loss above 20 kHz. The problem with the switching loss was reduced by using BDY91 transistors, which have very low saturation voltages but fast switching speeds.

The circuit is a self-oscillating, saturating, push-pull inverter, similar in concept to the earlier design. The frequency of operation of these circuits depends on the number of turns on the primary of the transformer and on the properties of the core material. In general, if the primary turns are decreased the oscillation frequency is increased, since the magnetic field intensity necessary to cause core saturation occurs sooner, and core saturation causes the circuit to toggle to the opposite state. (A more detailed description of this is included in the How It Works section.)



Our final prototype. We used two 20 W tubes housed in 'Safe-T-Lite' enclosures. Put protective plastic caps over the transistors to prevent shorts. One 'starter' wire (see circuit) can be seen wound around the top tube.

In the initial prototype designs we tried to use common potcores such as the FX2242 or FX2243. Unfortunately these have relatively large core loss above 20 kHz, and operation of the inverter for only 15 minutes caused core temperatures of well above 150°C. Furthermore, although it was possible to make the circuit oscillate above 20 kHz, this was achieved only by allowing the transistor to saturate in order to cause switching of the circuit. This was done by limiting the amount of base drive to the transistors so that when sufficient current flowed through the transistors a voltage drop would start to appear across them, causing switching. It was impossible to make the cores saturate before the transistors with a reasonable number of turns on the primary. The problem with this technique is that the increased voltage drop across the transistors causes an increase in the power dissipation in these devices, further decreasing the efficiency of the circuit.

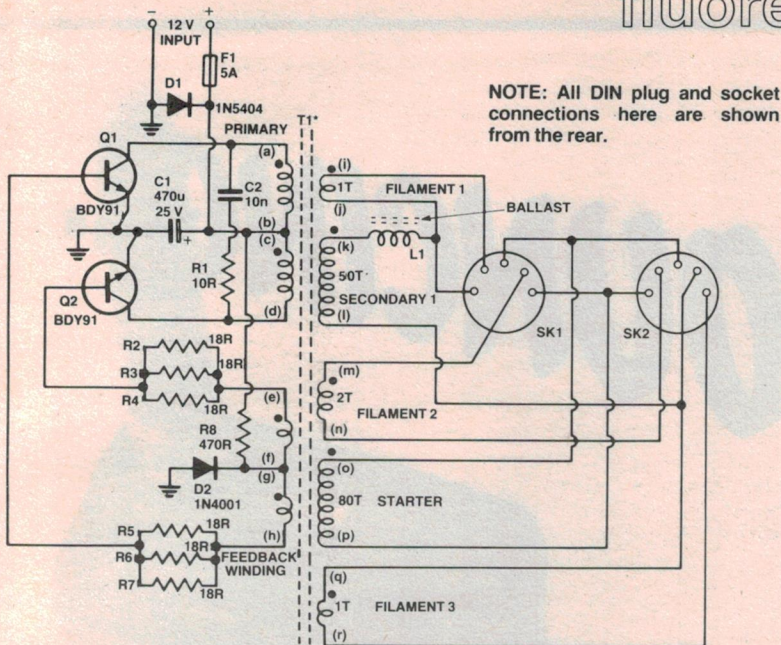
The solution, as mentioned above, was to use a core capable of working above 20 kHz with negligible loss. We chose Philips EC52/24/14 cores as we had previously used them in the

ETI-142 power supply (Feb. '79). They are commonly used in switch-mode applications and have been available for some years. See the 'Shoparound' page this issue for suppliers. The design uses four of these cores (they come in core halves), two for the main inverter transformer and two for the ballast inductor core.

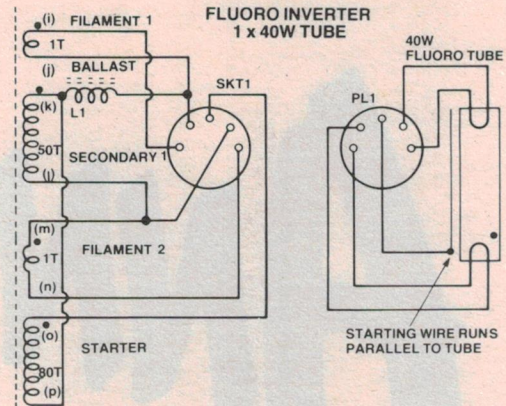
Fluorescent tubes, like most gas discharges, have a negative resistance and will pull extremely large currents if allowed to. To overcome this it is necessary to place an appropriate amount of impedance in series with the tube, limiting the current to a realistic value. A resistor of course cannot be used, since power dissipation would be enormous. Instead the ballast inductor is used, which has another advantage not immediately obvious. If the supply voltage to the inverter is decreased, by a slowly flattening battery for example, the frequency of oscillation and the output voltage will decrease. However, since the impedance of the ballast decreases at lower frequencies, the effect of decreased voltage is offset somewhat, and light output does not drop as much as expected. Similarly, if the voltage applied to the inverter is too



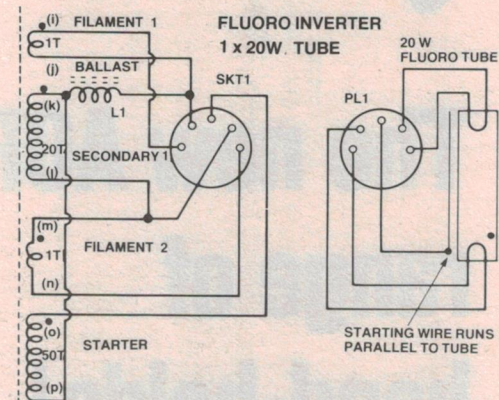
# fluorescent light inverter



NOTE: All DIN plug and socket connections here are shown from the rear.



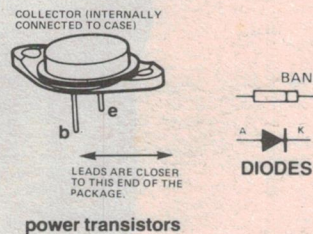
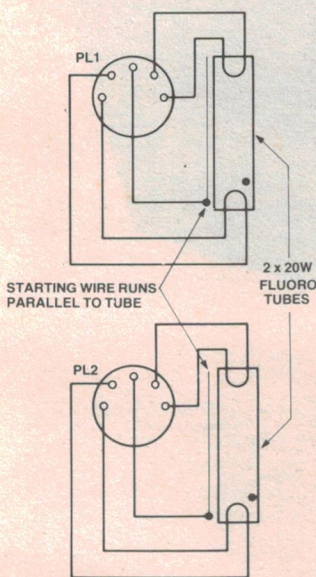
Arrangement for driving a single 40 W tube.



Arrangement for driving a single 20 W tube.

ABOVE: General circuit of the inverter, configured to drive two 20 W tubes, as in our final prototype.

BELOW: Tube wiring details. Note that they are connected in 'series'. The 'starter' wire brings about initial ionisation of the tube. It may be laid parallel to the tube or wound around it once or twice.



power transistors

## HOW IT WORKS — ETI-1505

The circuit is a push-pull, self-oscillating inverter. The moment the supply voltage is connected, current flows through the 470 ohm resistor, R8, through the feedback winding and current limiting resistors to the bases of Q1 and Q2. One of these two transistors will turn on, as both devices are not exactly matched in characteristics, and force the other transistor to turn off. If, for example, Q1 turns on, current will flow through a-b of the primary winding. This causes a magnetic field to build up in the transformer core creating a positive voltage on d, h, j, l, n, p and r (i.e.: the finish of each winding), the 'starts' being indicated by a ●. So, the base of Q2 is driven negative, forcing the transistor hard off. The base of Q1 is driven positive, driving the transistor hard on.

Since the primary of T1 acts as an inductor, the current flowing increases linearly for as long as the voltage is applied until finally the magnetic field intensity reaches a maximum, where the transformer core saturates. At this moment, the impedance of the core drops since the saturated core cannot maintain the relatively high inductance of the primary. The decreased impedance causes an increase in current flowing in the primary, driving the core even further into saturation until most of the coupling between coils on the transformer is lost. This causes the drive voltage to the transistor bases to disappear. Current stops flowing in the transformer and the magnetic field starts to collapse. This causes the

voltage sense of each winding to reverse and the start (●) of each changes from negative to positive. This removes charge from the base of Q1, which turns off, and drives the base of Q2 hard on. The whole sequence of events then repeats itself, only Q2 is now hard on and Q1 is hard off.

In this way, the circuit oscillates at a frequency determined by the core material, the number of primary turns and the applied voltage.

Resistor R1 and capacitor C2 serve simply as a 'snubber' to remove flyback voltage spikes from the collectors of the transistors, preventing destruction of the devices by over-voltage. Diode D2 is incorporated to enable starting of the circuit but is 'transparent' during operation.

The transformer secondaries are wound to provide the necessary voltages for either 20 W or 40 W fluorescent tubes maintaining voltage and filament voltage. The 'starter' winding is necessary to ionise the gas in the tube to induce the tube to light. This could be done by increasing the secondary voltage but this causes an unnecessary current consumption in the primary. A separate starter winding is by far the better approach and the one we have used.

The ballast inductor L1 serves to limit the current flowing through the tube(s) which have a negative resistance characteristic and can draw very high currents once lit, if allowed.

high, the oscillation frequency tends to increase, the impedance of the ballast increases, and once again the tube current is maintained closer to the optimum, ensuring good tube life.

This inverter can be configured to drive one 40 W tube, two 20 W tubes or one 20 W tube. However, the latter option is not recommended as actual power dissipation goes up! Batters for two 20 W tubes and for a single 40 W tube are readily obtainable from lighting suppliers and it is possible to build the inverter into these. We elected to have a pair of 'portable' 20 W tubes driven from the one inverter, constructed in a convenient aluminium box.



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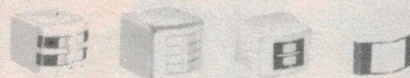
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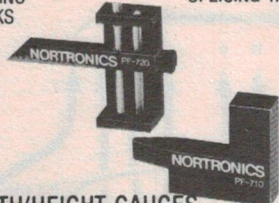
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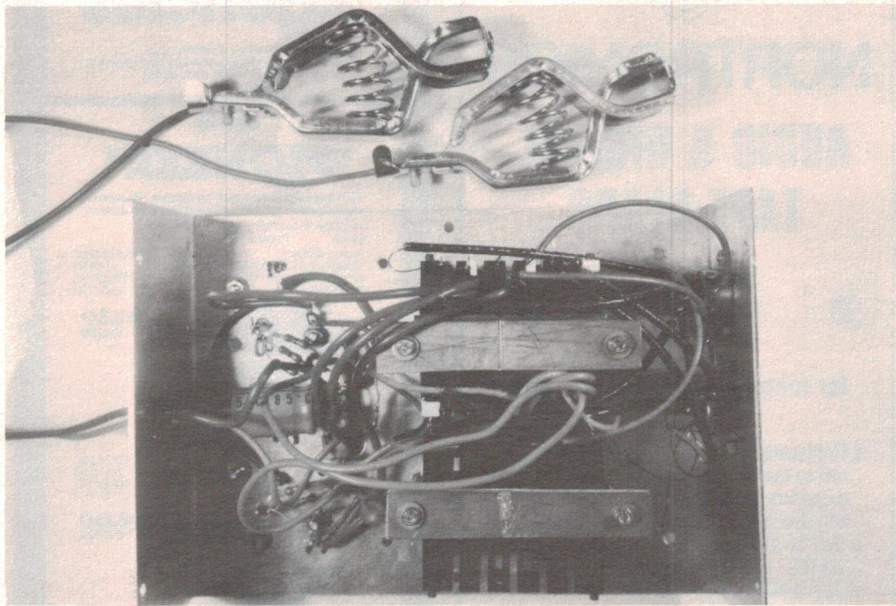


**1 INCH DOME TWEETER**  
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Power Rating 25 WATT (RMS)  
Cross Over Freq (to) 2000 Hz  
Nominal Sensitivity 95 (dB/W)  
Response Range 2,000-20,000 Hz  
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# Project 1505



Internal view of our final prototype inverter, showing general layout. The inverter transformer, T1, is at upper right, the ballast, L1, below it.

## Construction

Best place to commence is with the hardware. We housed the unit in an aluminium case we had to hand that measured 170 mm long by 125 mm wide by 55 mm deep. This allowed plenty of room to mount everything. Any housing of a suitable size could be used, or the circuitry could be built into the base of a fluorescent light batten.

You'll need to drill TO-3 mounting hole patterns for the two power transistors (Q1 and Q2). Use an insulating washer as a template. The two transistors can be mounted adjacent to one another. We mounted ours 50 mm apart (between centre lines), toward one end

of the box. The 7-lug tagstrip was mounted between them, toward the middle of the box, allowing plenty of room to mount the transformer and ballast in the area left. The two DIN sockets were mounted on the end panel, at the end of the box opposite the transistors. You'll need to drill suitable holes for the transformer mounting clamps. While the transformer assemblies are generally supplied with special mounting clamps, these may sometimes be unavailable. We didn't have any so fashioned some out of some 55 mm long bolts and a scrap of pc board for a top clamp (either remove the copper or cut it so that the bolts, chassis and clamp don't

make a shorted turn around the core). When you're mounting transformer T1 later, its core should be separated from the chassis a little by a strip of cardboard or pc board. This reduces eddy current losses in the chassis and core and reduces chassis and core heating during operation.

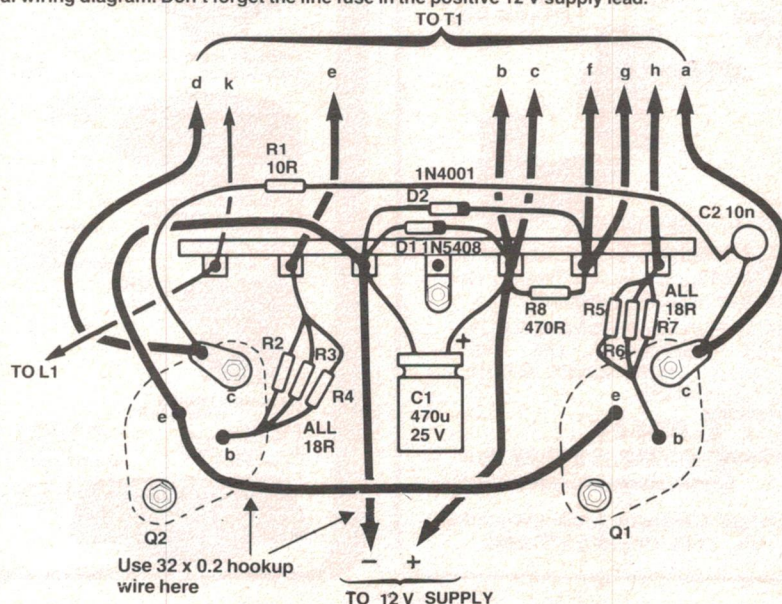
We leave the exact details to you as individual construction will likely vary considerably.

With the chassis drilled, mount the transistors first, using insulating washers, thermal compound and bushes for the mounting bolts. Put a solder lug under one mounting nut on each transistor (inside the chassis) for collector connections.

Next mount the tagstrip and solder in the resistors, capacitors, diodes and transistors, so far as possible. Refer to the wiring diagram.

Wind T1 and L1 next. Details are given in the accompanying panel. Having completed T1 and L1, assemble and mount T1 first. Sleeve all enamelled copper wire flying leads with spaghetti insulation. Make sure you can identify each lead. Wire up T1 according to the circuit and wiring diagram. Take particular care wiring up the DIN socket or sockets — depending on whether

General wiring diagram. Don't forget the line fuse in the positive 12 V supply lead.



## PARTS LIST — ETI-1505

### Resistors ..... all ½W, 5%

R1 ..... 10R  
R2, 3, 4, 5, 6, 7 ..... 18R  
R8 ..... 470R

### Capacitors

C1 ..... 470u/25 V RB electro.  
C2 ..... 10n ceramic

### Semiconductors

D1 ..... 1N5404 or similar  
D2 ..... 1N4001 or similar  
Q1, Q2 ..... BDY91 or BDY92

### Miscellaneous

F1 ..... 5 A fuse and in-line fuseholder  
PL1, PL2 ..... 5-pin DIN plugs  
SK1, SK2 ..... 5-pin DIN sockets (chassis-mount)  
L1 ..... Philips EC-core assembly (windings — see text)  
2 x EC52/24/14 cores (4322-020-52520)  
1 x former, no tags (4322-021-33020)  
clamp assembly:  
1 x 52PLATE,  
1 x 55UBOLT,  
2 x 632NC2A.  
T1 ..... as per L1

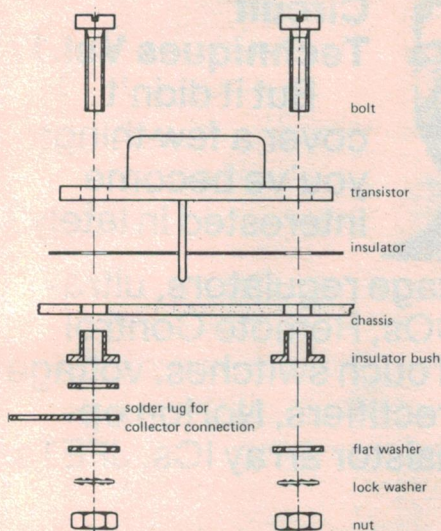
One 20 W or one 40 W or two 20 W fluorescent tubes; housing(s) to suit tube(s); case for electronics; one 7-way tag strip; battery cable (pair of 32 x 0.2); battery connectors; nuts, bolts, wire etc.

**Price estimate \$35 — \$40**

not including fluoro tubes and tube housing(s)



# fluorescent light inverter



Mounting Q1 and Q2

you're using one 20 W, one 40 W or two 20 W fluorescent tubes.

Mount the ballast inductor, L1, but don't secure it in place too permanently yet as you'll need to set up the inverter by 'gapping' the core. Put spaghetti on the flying leads of L1 also.

Now the tube or tubes can be wired up. We used two 20 W tubes mounted in 'Safe-T-Lite' plastic tubes with rubber ends which we obtained from Warburton Franki. Some kit suppliers may be able to supply these along with kits. Wiring to the fluorescent tubes may be done with ordinary hookup wire — the filament pins may be soldered to directly. The 'starting' wire is attached to the tube with glue or tape. We used hookup wire run the length of each tube. It is not connected to any part of the tube. For the lead from the tubes to the DIN plugs, we used five-core double-insulated cable, which should not be too difficult to obtain.

## Setting-up procedure

Before powering up, make sure the ballast inductor core halves are in good contact with one another. Now, plug in your fluoro tube or tubes, connect the inverter to a 12 V battery or power supply (it should be capable of 4-5 A), and switch on. The tube should light smoothly and you should be able to hear the inverter oscillating at around 12-15 kHz (if your ears are OK). If the tube doesn't light or the inverter doesn't oscillate, switch off and check your wiring. If all seems OK, reverse connections 'e' and 'h' on the feedback winding and power up again. This time the inverter should spring to life — if not, you still have a problem. Sort it out

before continuing.

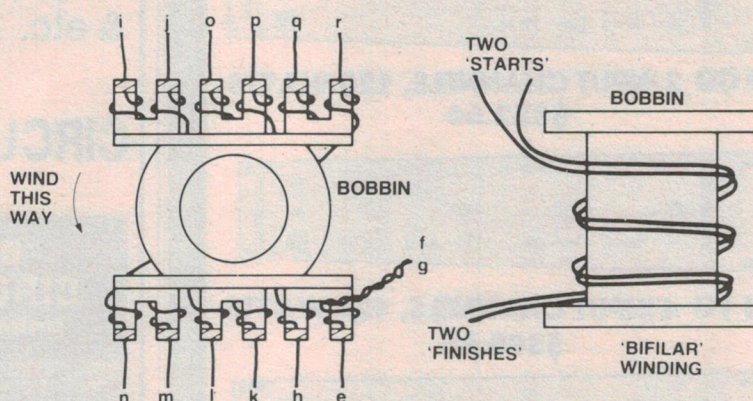
Assuming your inverter now works, you can proceed with adjusting the ballast inductor.

For correct operation, the inductance of L1 needs to be set by 'gapping' the core, limiting the maximum current through the fluorescent tube or tubes. To do this, insert an ammeter in series with one 12 Vdc supply lead, set to read 5 A (max.) if you have a 40 W load (one 40 W tube or two 20 W tubes), or 3 A (max.) if you have a 20 W tube.

We found the best gap was obtained by taking a small piece of paper, cut from a page of ETI, and inserting it between the faces of one 'leg' of the core halves! Clamp the assembly firmly. Then, apply power and measure the supply current. It should be within 100 mA of 4.5 A for correct operation on a 40 W load with a supply of between 12 and 14 volts. For a 20 W load, the current should be around 2.5 A.

That's it! May your little light shine brightly.

## WINDING T1 AND L1



### Components required:

Two Philips EC core assemblies, each consisting of:-

2 x EC52/24/14 cores — 4322-020-52520

1 x former, no tags — 4322-021-33020

1 x clamp assembly as follows:

1 x 52PLATE, 1 x 55UBOLT, 2 x 63NC2A

### Wire required:

About 4 m of 0.4 mm dia. enamelled copper wire.

About 1 m of insulated hookup wire (10 x 0.2 mm).

About 1 m of heavy duty insulated hookup wire (32 x 0.2 mm).

**L1:** Wind 40 turns of 0.4 mm enamelled copper wire (about 1 m) on one bobbin, tying off the ends to convenient posts on the bobbin end cheek. Spread the winding over the bobbin. Leave about 100 mm or so of lead length.

**T1:** Commence with the 'starter' winding (o/p). For this you'll need about 120 cm of 0.4 mm enamelled copper wire. Referring to the accompanying drawing, tie off the start (o), leaving about 100 mm or so of lead. Wind on **80 turns**, spreading the winding over the bobbin. Tie off the end (p) adjacent to the start, as shown in the diagram, leaving another 100 mm or so of lead.

Do **secondary 1** next. This requires 0.4 mm enamelled copper wire. The number of turns required depends on which tube or tubes you intend to run. Consult the 'windings' table. As for the first winding, commence by tying off the start (k) then wind on the required number of turns, spreading the wire over the former. Again, start and finish leads should be 100 mm or more.

Now wind the three filament windings. **Filament 1** and **filament 3** are each **one turn** of enamelled copper wire. **Filament 2** is **two turns**.

The **feedback winding** comes next. This is wound **bifilar** using the lighter duty insulated hookup wire (10 x 0.2 mm). Take a pair of wires, laid side by side, and wind **one turn** on the bobbin, tying off the ends leaving long flying leads. Twist together one start and one finish for the centre tap (f & g).

An illustration of bifilar winding (showing three turns) is given in the accompanying diagram.

The **primary** winding comes last. This too is wound **bifilar**, using the heavy duty hookup wire (32 x 0.2 mm). Wind on **three turns**, tying off the leads, leaving long flying leads as for the feedback winding. Twist together one start and one finish for the centre tap (b & c).

### Windings

**L1** 40 turns, 0.4 mm enam. copper wire.

**T1 primary** (a-b, c-d)

3 turns, bifilar, 32 x 0.2 mm insul. hookup wire.

**feedback** (e-f, g-h)

1 turn, bifilar, 10 x 0.2 mm insul. hookup wire.

**filament 1** (i-j)

1 turn, 0.4 mm enam. copper wire.

**secondary 1** (k-l)

single 20 W tube: 20 turns, 0.4 mm enam. copper wire.

two 20 W tubes: 50 turns, 0.4 mm enam. copper wire.

one 40 W tube: 50 turns, 0.4 mm enam. copper wire.

**filament 2** (m-n)

2 turns, 0.4 mm enam. copper wire.

**starter** (o-p)

80 turns, 0.4 mm enam. copper wire.

50 turns for 1 x 20 W tube

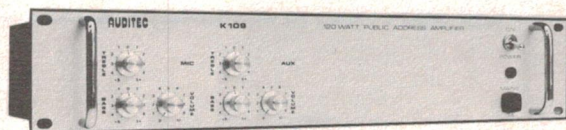
**filament 3** (q-r)

1 turn, 0.4 mm enam. copper wire.



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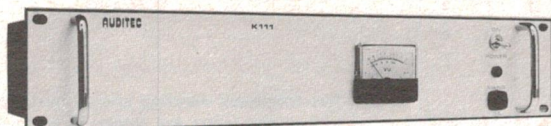
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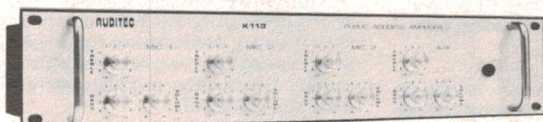


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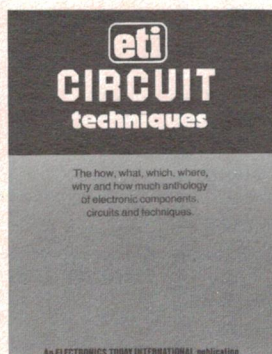


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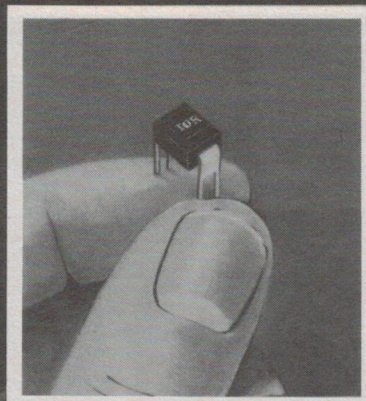
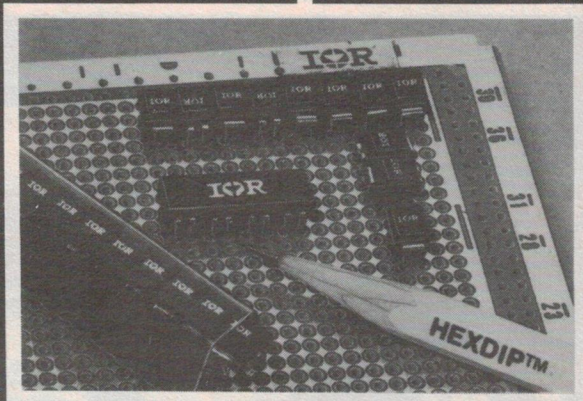
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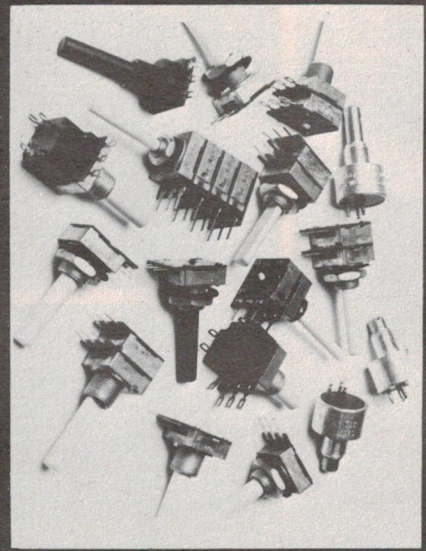
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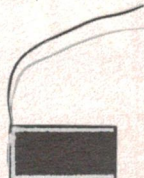
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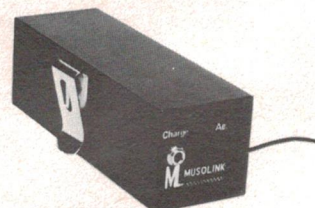
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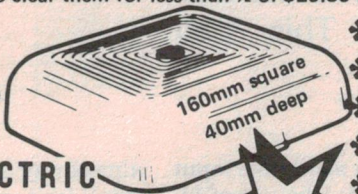
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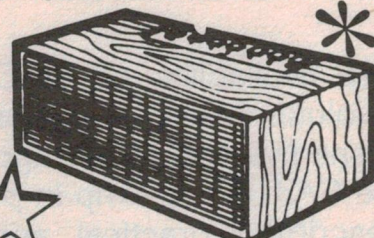


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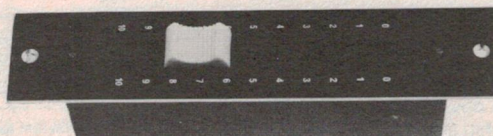
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# Lab Notes

## Using BiFET and BiMOS op-amps

The availability of BiFET and BiMOS op-amps has revolutionised circuit design since they appeared on the scene five or so years ago. While we've used devices like the CA3140 op-amp in projects we've not got around to describing practical applications circuitry. This 'Lab Notes' fills that gap.

**Brian Dance**

THE AVAILABILITY of BiFET and BiMOS devices in various packages with one to four operational amplifiers per package has revolutionised the operational amplifier market. Apart from the relatively expensive hybrid FET input devices, other FET input operational amplifiers had been available for some considerable time, so why should BiFET and BiMOS devices be so important?

The first point to note is that amplifiers with FET input stages can offer far higher input impedances than devices with ordinary bipolar transistors in their input stages. For example, the well-known 741 has an input impedance

of the order of 1M and a maximum input bias current of 500 nA. The use of bipolar transistors to obtain a high input impedance has been pushed to the limit in devices such as the LM108, using supergain input devices to provide a typical input impedance of 70M and an input bias current of just under 1 nA. These values may be compared with those of some of the economical BiFET and BiMOS devices, where typical input impedances are of the order of 1 Terraohm (one million Megohms!) and input currents are some tens of picoamps (pA) at room temperature.

Thus if one connects the input of one of these BiFET or BiMOS amplifiers to

almost any circuit, it will impose a very small load on that circuit. This can be a vital consideration when one is designing such high-impedance circuits as those used in pH meters or in ionisation chamber smoke detector circuits, whose output current is inadequate to drive devices such as the 741.

If one considers the very early types of monolithic FET input operational amplifiers (such as the Fairchild  $\mu$ A740), they do have the desired high input impedance, but their disadvantage is that their input offset voltage and its temperature coefficient are so high that they do not approach the high standard of performance required by the modern

### INTRODUCTION TO THE BIMOS AND BIFET OP-AMP

The first BiFET products were announced by National Semiconductor in 1975 (the LF155, LF156 and LF157 series, where LF signifies Linear FET device). The main advantages of these products is that the junction FET devices used in their input stages are fabricated on the same silicon chip as the remainder of the operational amplifier. Although hybrid operational amplifiers with FET input stages had been available for some considerable time previously, all of these hybrid devices contained the junction FET devices fabricated on a separate silicon chip from the remainder of the operational amplifier. Such hybrid devices can be made to have a very good performance if adequate trouble is taken in their design, but the extra labour costs involved in the testing of the separate chips for appropriate matching characteristics and in connecting the two chips in a single hybrid package inevitably resulted in a price

tag far above that of modern BiFET devices. The general type of construction of a BiFET device is shown in Figure 1, the channel between the source and the drain electrodes of the FET input devices being fabricated by ion implantation.

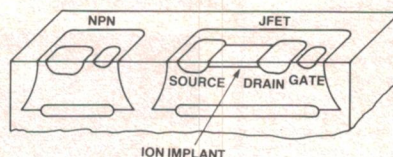


Figure 1. Construction of a BiFET device.

Although National Semiconductor produced the first BiFET products, it was not long before other manufacturers entered the BiFET market, and such products are now available from Advanced Micro Devices, Analog Devices, Fairchild, Harris

Semiconductor, Motorola, Intersil, Precision Monolithics, Raytheon and Texas Instruments, although National Semiconductor still offer the widest range of BiFET products, details of which can be found in their Linear Databook.

Very soon after National Semiconductor had announced the first BiFET products, RCA introduced their first BiMOS product, the economical CA3130 operational amplifier. This has some similarities to the BiFET amplifiers, but employs MOSFET transistors in the input stage rather than junction FET devices. RCA soon introduced further BiMOS devices, one of the best known type being the CA3140, which can be used as a pin-for-pin replacement for the 741 when a higher performance is required. More recently the CA080 series has been introduced as pin-for-pin replacements for the Texas Instruments series of TLO80 BiFET types.



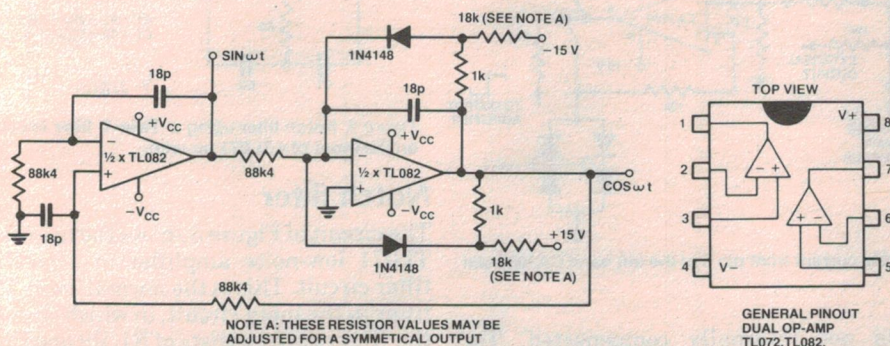


Figure 3. Quadrature oscillator producing two outputs 90° out of phase, using a TL082 dual op-amp — pinout at right.

professional engineer. Modern BiFET and BiMOS devices provide a very high input impedance with relatively good stability and temperature performance — although the input impedance of any of these devices at 25°C is much greater than over the full temperature range.

In general BiFET and BiMOS economical devices offer a comparable performance. If anything, BiMOS devices tend to offer the lower input bias currents and BiFET products the lower noise levels. However, premium devices of both types are available with performances far above the average for the type of device concerned.

## Half-Hertz oscillator

Figure 2 shows the use of the economical TL081 device in a simple 0.5 Hz square wave oscillator. The TL081 is a

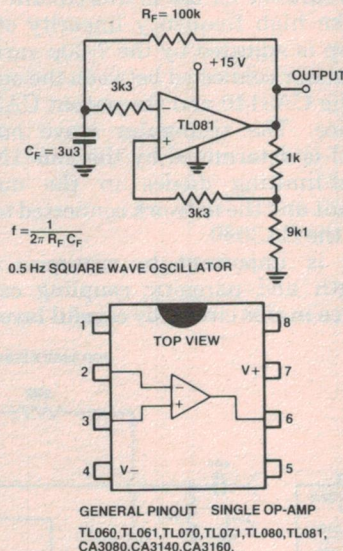
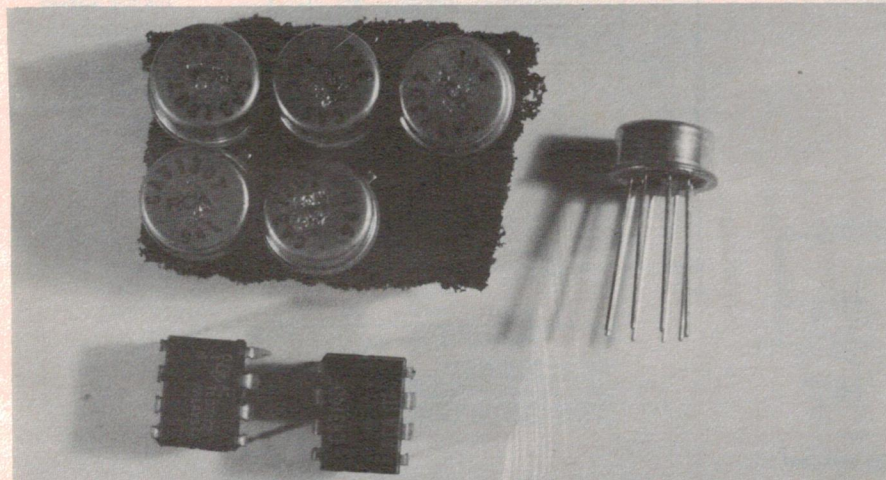


Figure 2. Half-Hertz oscillator using a TL081 — pinout below.



Modern BiMOS and BiFET op-amps come in both can and DIP packages.

single operational amplifier in a dual-in-line package with the connections shown in Figure 2; the pin connections are the same as those of the well-known 741 devices, internal frequency compensation being employed so that no external compensating capacitor is required. External offset adjustment can be made when required by means of an external variable resistor. The TL071 is a similar low-noise device with the same connections, and is quite suitable for use in this circuit, but its low-noise characteristics are not needed. The TL061 is a low-power device with the same connections.

The frequency of oscillation of the Figure 2 circuit is given by  $f = 1/(2\pi R_F C_F)$ , or about 0.5 Hz with the values shown. The high input impedance of the circuit enables a relatively high value of feedback resistor,  $R_F$ , to be employed, so the value of  $C_F$  can be reasonably small for a given frequency of operation. About nine-tenths of the output voltage is fed back to the non-inverting input to provide positive feedback to maintain oscillation. The capacitor  $C_F$  charges and discharges through  $R_F$  according to whether the state of the output voltage is 'high' or 'low' at the time concerned.

The circuit of Figure 2 generates square waves which are approximately symmetrical. However, if a circuit which generates waves with an unequal mark-to-space ratio is required, it is only necessary to connect a resistor of perhaps 10k to 50k in series with a diode across  $R_F$ . The direction in which the diode is connected determines whether the output spends the greater part of its time in the 'high' or in the 'low' state.

## 100 kHz oscillator

Figure 3 shows the circuit of a 100 kHz oscillator providing two outputs which are 90° out of phase with each other. Although the TL081 is perfectly satisfactory for use in this circuit, it is more convenient to use the dual TL082 device so that this one device is all that is needed. The connections of the 8-pin dual-in-line TL082 device are shown in Figure 3; it employs internal frequency compensation, but has no external offset adjustment facilities.



# Lab Notes

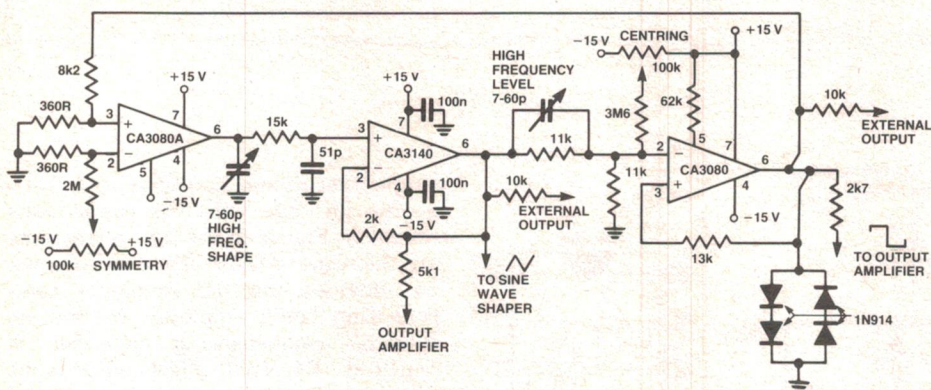


Figure 4. Function generator circuit. Sourcing or sinking current from pin 5 of the left hand CA3080 will vary the frequency.

## BiMOS generator

A function generator which produces square and triangular waveforms is shown in Figure 4. It employs a CA3140 BiMOS device together with a CA3080A and CA3080. A particular feature of this circuit is that a frequency range of one million to one can be obtained by the use of a single variable resistor, or alternatively by the use of an auxiliary sweeping signal.

A CA3130 device may be employed instead of the CA3140 shown, but in this case a frequency compensating capacitor (about 56p) must be connected between pins 1 and 8, since the CA3130

is not internally compensated. The CA3160, which does not require any external frequency compensation, is also suitable for use in this circuit.

The high frequency linearity of the ramp is adjusted by the 7-60p variable capacitor connected between the output of the CA3140 and the output CA3080 device. The triangular wave output level is determined by the four 1N914 level-limiting diodes in the output circuit and the network connected to pin 2 of the CA3080.

It is important to minimise lead length and parasitic coupling capacitance in this circuit by careful layout.

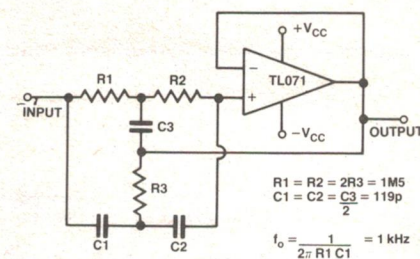


Figure 5. Notch filter using a 'Twin-T' filter section on the input of a TL071 op-amp.

## Notch filter

The circuit of Figure 5 shows the use of a TL071 low-noise amplifier in a notch filter circuit. This is the normal 'twin-T' filter in the input circuit, in which one of the 'T' sections consists of R1, R2 and C3 and the other part of C1, C2 and R3. It is designed to reject signals of one particular frequency (the notch frequency), whilst passing signals of any other frequency virtually unattenuated.

For optimum performance, when a sharp notch in the frequency response is required, the components should have matched values (to within 1% or 2%). When the values shown are employed, the notch frequency occurs at approximately 1 kHz. An advantage of using a high input impedance device such as the TL071 is that relatively large values may be employed for R1, R2 and R3 and,

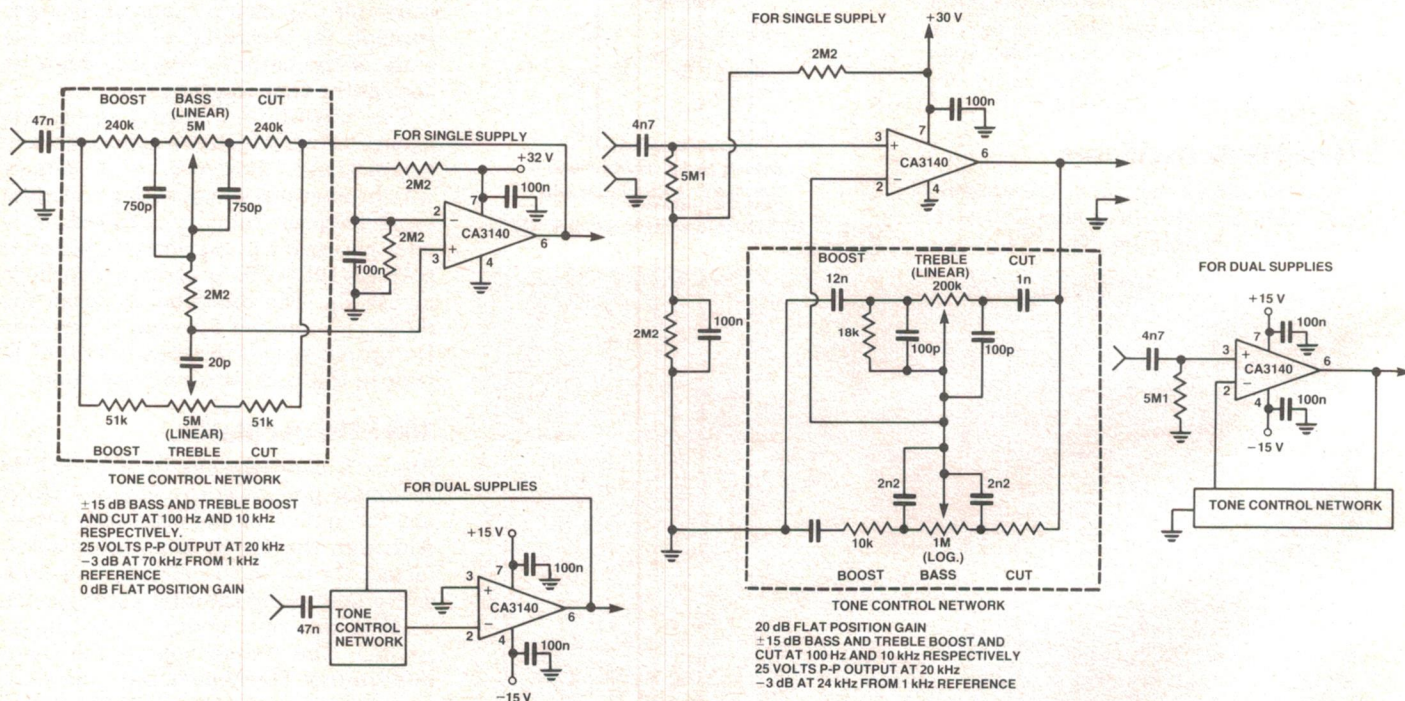


Figure 6. Baxandall type tone control circuitry, with unity gain (flat position).

Figure 7. Tone control circuit with 20 dB of gain, flat position.



## Tone controls

Bass/treble boost or cut are about  $\pm 15$  dB at 100 Hz and 10 kHz respectively. Full peak-to-peak audio output is available up to at least 20 kHz, since the CA3140 has a relatively high slew rate (about 7 V/us). The gain falls by about 3 dB at a frequency of around 70 kHz.

[illegible]

A tone control circuit using the TL060 low-noise BiFET devices is shown in Figure 8. The TL060 is not internally compensated and therefore requires the 10p external frequency compensation capacitor shown connected in the circuit of each device. Similar circuits can, of course, be made using the TL080 devices at the expense of a higher power level. A further alternative is the use of TL066 programmable BiFET device without any compensating capacitors, but with a suitable value of the programming resistor between pin 8 and the negative line (about 1k, depending on the trade-

## Mic preamp

### Distribution amp

circuit for an audio distribution amplifier using one of these quad devices. The input stage acts as an input buffer and the other three stages act as output buffers, so that no signal from output A finds its way into any of the other outputs.

GENERAL PINOUT  
QUAD OP-AMP  
TL064, TL074, TL084.

**IC PREAMPLIFIER RESPONSE CHARACTERISTICS**

The graph plots Voltage Amplification (dB) on the y-axis against Frequency (Hz) on the x-axis. The y-axis ranges from -25 to 25 dB in increments of 5. The x-axis is logarithmic, ranging from 20 Hz to 20 kHz with major ticks at 20, 40, 100, 200, 300, 700, 1k, 2k, 4k, 7k, 10k, and 20k. Two curves are shown: a low-pass response (labeled 'MAX. BASS' at the top left and 'MIN. TREBLE' at the bottom right) and a high-pass response (labeled 'MIN. BASS' at the bottom left and 'MAX. TREBLE' at the top right). Both curves intersect at 0 dB at a frequency of 1 kHz. The graph is set against a grid with vertical lines every 100 Hz and horizontal lines every 5 dB.

$\pm V_{CC} = \pm 15V$        $T_A = 25^\circ C$

**Figure 9. Response characteristics of the Figure 8 circuit.**



# Lab Notes

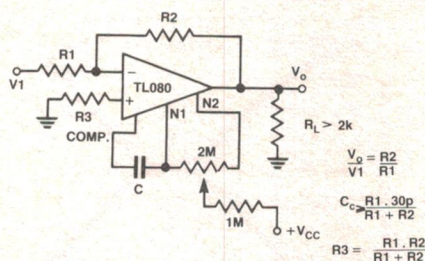


Figure 12. Simple voltage-variable gain amp using the TL080.

## Variable gain

The simple circuit of Figure 12 is an amplifier which provides a variable gain set by the potentiometer. A TL080 device is employed, so the compensating capacitor  $C_c$  is required, since this device is not internally compensated.

## Ice warning

The circuit of Figure 13 employs three of the four amplifiers of the TL084 device in an ice warning detector. It is especially suitable for use in vehicles to warn the driver when the temperature of the thermistor (placed outside the vehicle) falls below  $0^\circ\text{C}$ .

When the temperature of the thermistor falls, its resistance rises and the current flowing through the thermistor decreases. Thus the inverting input of the TL084 connected to this thermistor receives less current from the positive supply line and its output voltage tends to rise. This output voltage is fed to the TL084 output amplifier and produces a voltage across the LED, which lights, providing the required warning.

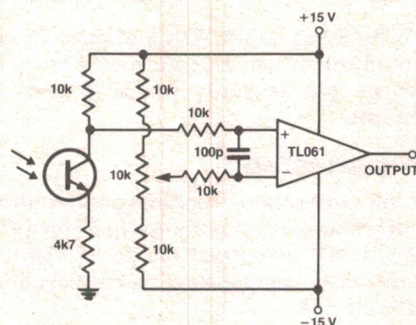


Figure 14. Low-level light detector using FPT100 or similar phototransistor.

## Light detector

The circuit of Figure 14 is a low-level light detector preamplifier using the low-power TL061 device with a TIL601 or similar phototransistor. The variable resistor can be used to balance the output at any particular value of light level.

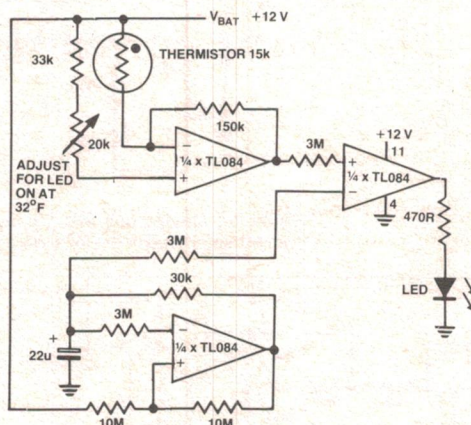


Figure 13. An ice warning indicator.

## Sine shaper

The circuit shown in Figure 15 uses a CA3140 as a voltage follower device in combination with diodes from the CA3019 array to convert the triangular signal from a function generator into a sinewave output, which has typically less than 2% harmonic distortion.

The circuit is best adjusted using a distortion analyser, but a fairly good adjustment can be made by comparing its output signal on an oscilloscope with that from a good sinewave signal generator. The initial slope is adjusted by  $R_1$ , followed by an adjustment of  $R_2$ . The final slope is established by adjusting  $R_3$ , thereby adding additional segments that are contributed by these diodes. Repetition of the adjustments may be necessary, since there is some interaction between the adjusting potentiometers.

## Wien bridge

A CA3140 BiMOS amplifier is used in the circuit of Figure 16, together with a CA3019 diode array, to form a Wien bridge oscillator. The zener diode shunts the 75k feedback resistor and, as the output signal amplitude increases, the zener diode impedance rapidly decreases so as to produce more feedback, with a consequent reduction in gain. This action stabilises the output signal amplitude. This combination of a monolithic zener diode and the bridge rectifier tends to provide a zero temperature coefficient for this regulating system.

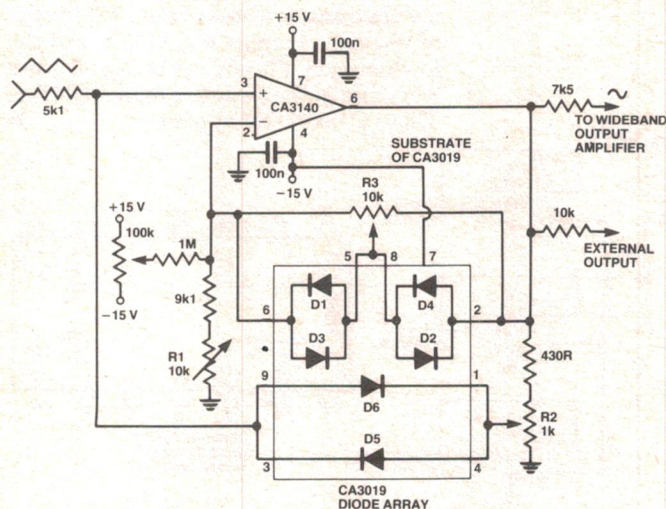


Figure 15. A triangle-to-sine waveshaping circuit employing a CA3140 op-amp and a CA3019 diode array.

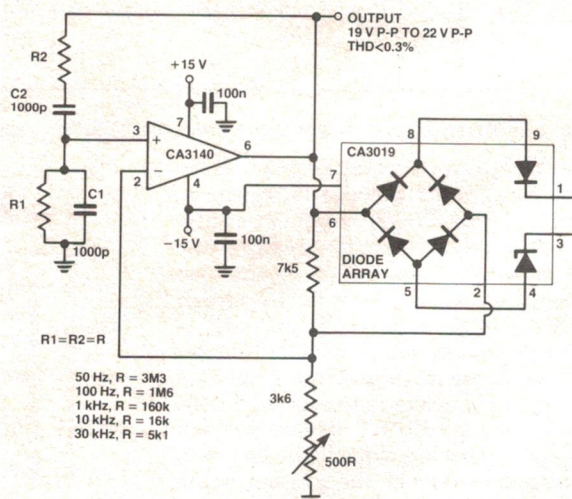


Figure 16. A Wien bridge oscillator featuring amplitude stabilisation via the zener action from the CA3019 diode array.



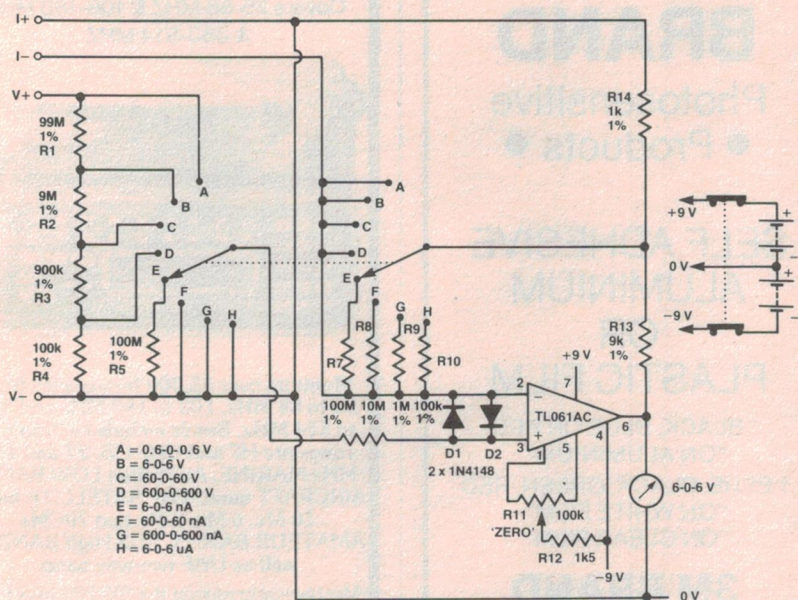


Figure 17. A multi-range voltmeter with high impedance input plus multi-range low-current meter.

As the output circuit contains no RC time constant, there is no lower frequency limit for operation. If  $C1 = C2 = 1\mu$  (polycarbonate) and  $R1 = R2 = 22M$ , the operating frequency can be about 0.007 Hz. At high frequencies, as the frequency is increased the amplitude of the signal must be reduced to prevent slew rate limiting from taking place. An output frequency of about 180 kHz will reach a slew rate of about 9 V/us when the output voltage amplitude is about 16 V peak-to-peak.

## Meter

The high input impedance of BiFET and BiMOS devices has led to their use in many voltmeters of high input resistance and also in meters to measure very small currents.

The circuit of Figure 17 was designed by Texas Instruments for the measurement of voltages in the range  $\pm 0.6$  V to  $\pm 600$  V, where the source resistance may be quite high, and to measure currents from 6 nA to 6 uA. The instrument was required to accept inputs of either polarity and be inexpensive, robust and reliable. It also had to have a long battery life, so a TL061 low-power operational amplifier device was selected. An inexpensive centre zero meter is considerably cheaper than a liquid crystal display and would provide adequate accuracy for the purpose.

When the switch is in one of the positions A to D inclusive, the instrument is set for the measurement of voltages.

The amplifier has a non-inverting gain of 10 and range selection is achieved by a simple potential divider network with a fixed input impedance of 1000 megohm. A panel-mounted 'centre zero' control is included in the circuit to facilitate corrections for the mechanical movement of the meter zero and for the change in the operational amplifier input voltage offset (for example, with temperature).

In the current measuring mode of switch positions E to H inclusive, the amplifier operates as a current-to-voltage converter. For the most sensitive range of 6 nA, a transimpedance of 1 Gigaohm is required to produce a full-scale deflection of the meter. Rather than use a resistor of such a high value, a resistance multiplier arrangement was devised with a 100M feedback resistor for the most sensitive range.

The two diodes across the input of the operational amplifier in conjunction with R6 provide protection against any

gross overloading of the instrument. A suitable arrangement incorporating a fullwave rectifier into this circuit would allow alternating input signals to be measured, but arrangements would have to be made to allow for frequency roll-off of the response at high frequencies.

## 3 pA meter

A CA3160 and a CA3140 are used in the circuit of Figure 18 to construct a picoammeter with  $\pm 3$  pA full scale deflection (one picoamp =  $10^{-12}$  amps). Pins 2 and 4 of the CA3160 are connected to ground, so the input pin 3 between them is effectively 'guarded'. If slight leakage resistance is present between terminals 3 and 2 or 3 and 4, there would be zero voltage across this leakage resistance and this would reduce the leakage current by a large factor.

It is preferable to operate the CA3160 with its output pin 6 near the ground potential, so as to reduce the dissipation by reducing the device supply current. The CA3140 serves as a  $\times 100$  gain stage to provide the required plus and minus output voltage swing for the meter and feedback network. A 100:1 voltage divider network consisting of a 9k9 resistor in series with a 100 ohm resistor sets the voltage at the 10 kMohm resistor to  $\pm 30$  mV full-scale deflection. This 30 mV signal results from  $\pm 3$  V appearing at the top of the voltage divider network, which also drives the meter circuitry.

It is possible to switch the 9k9 and 100 ohm network in the output circuit so that current ranges from 3 pA to 1 nA can be handled using the single 10kM resistor.

The writer has seen circuits using BiMOS devices published for use in measuring currents down to 100 femtoamps (0.1 pA), but obviously extreme care is required to ensure the insulation is adequate when such small currents are being measured. ▶

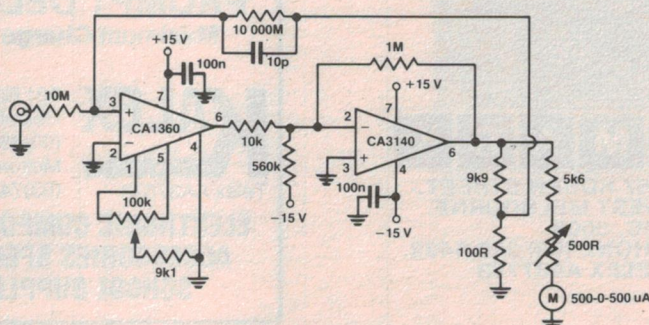


Figure 18. This circuit will measure very low currents — full-scale deflection is  $\pm$  three picoamps!



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# Lab Notes

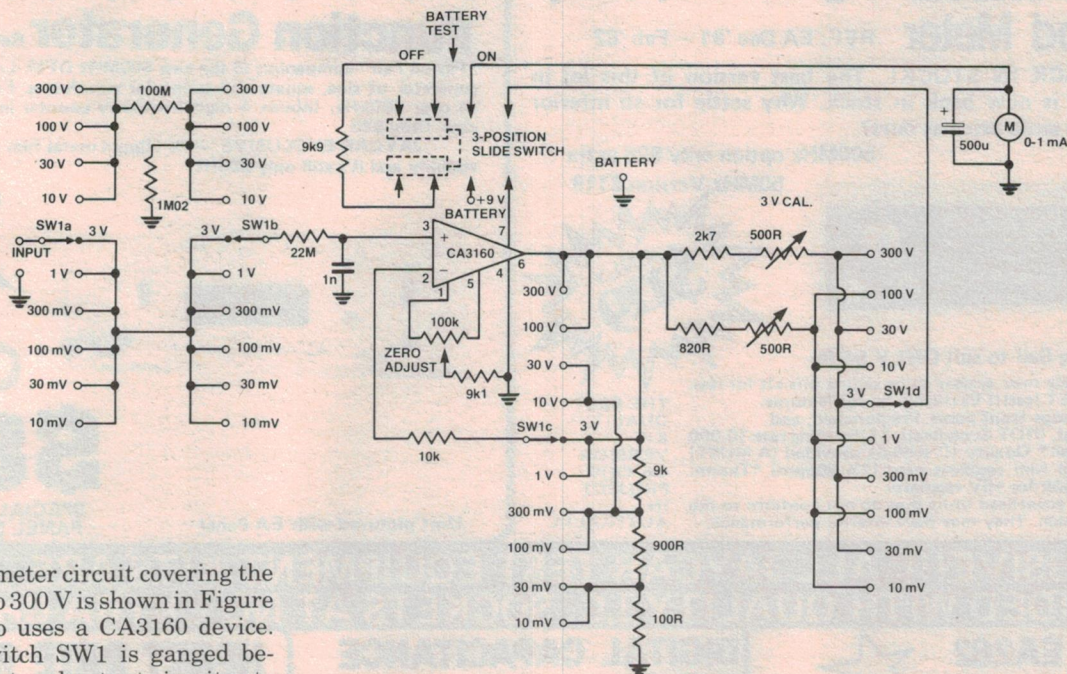


Figure 19. Example of a multi-range voltmeter measuring from 10 mV to 300 V.

## Voltmeter

A further voltmeter circuit covering the range 10 mV to 300 V is shown in Figure 19, which also uses a CA3160 device. The range switch SW1 is ganged between the input and output circuitry to enable the proper output voltage for feedback to terminal 2 through the 10k resistor to be selected.

This circuit is powered by a single 8.4 V mercury battery, the power supply current being somewhat less than 500 uA plus the meter current required to indicate a given voltage. Thus the supply current rises to about 1.5 mA at full-scale deflection.

Any readers who experience problems

in obtaining a CA3160 may use a CA3130 with a frequency compensation capacitor of about 56p between pins 1 and 8.

The aim of this article has not been to introduce readers to all the latest

BiFET and BiMOS devices (of which there are large numbers), but rather to give an indication of the wide selection of circuits that can be made with just a few of the standard types of device which are readily available.

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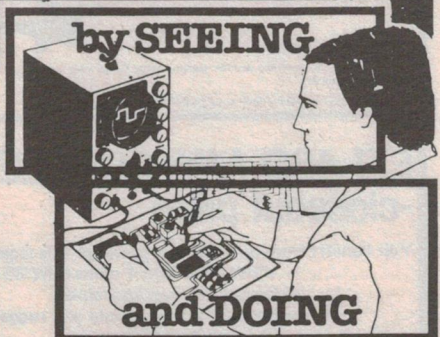
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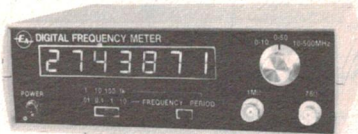
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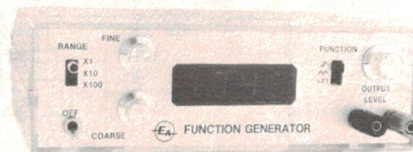
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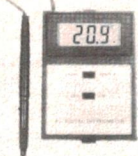
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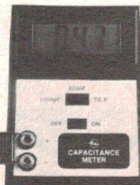


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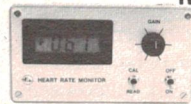
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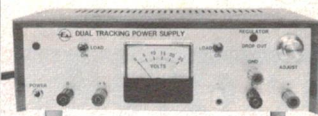
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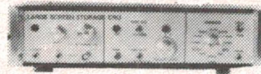


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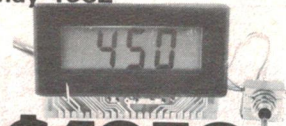
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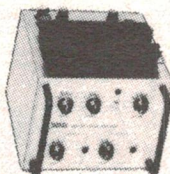
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DISTORTION  
(@ 2 volts out)  
FREQUENCY RESPONSE  
-EQ OUT  
-EQ IN  
SIGNAL TO NOISE RATIO  
(@ 2 volts out, controls flat)  
OUTPUT IMPEDANCE  
MAXIMUM INPUT  
VOLTAGE  
EQ centre frequencies

Less than .04% 20Hz-20KHz

Flat

20Hz-20KHz±1dB

Greater than 85dB

50k to 100k depending on the input configuration

10 volts

21.5, 40, 50, 63, 80, 100, 120, 160, 200, 250, 315

400, 500, 630, 800, 1K, 1.25K, 1.6K, 2K, 2.5K,

3.15K, 4K, 5K, 6.3K, 8K, 10K, 12.5K, 16K, Hz

Range of controls  
Individual Filters  
Level  
EQUALISATION

LEVEL

EQ BYPASS

POWER

Terminations

PHYSICAL

Size

Weight

Finish

+10dB

+15dB

28 Vertical potentiometers continuously variable

+10dB

Rotary potentiometer variable +15dB

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Input and output

19" x 3 1/4" x 8" (standard rack mount size)

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Front panel brushed and anodized black with lettering, black Marvplate cover.

The 2801 is a single channel graphic equaliser that divides the audio spectrum into twenty eight one third octave bands. Each frequency segment is controlled by a slider that provides up to -10dB of adjustment in standard ISO steps. The 2801 was designed primarily to compensate for any deficiencies in the linearity of speaker systems, acoustic peculiarities of the hall or listening room, and inadequacies of program source quality.

In P.A. application the equaliser may be used to improve sound quality and increase intelligibility by attenuating problem frequencies that cause ringing, boominess or other disruptive resonances that occur in acoustically difficult rooms. The 2801 allows sound systems to be "tuned" according to the special acoustics of a room, to maximize output and minimize feedback.

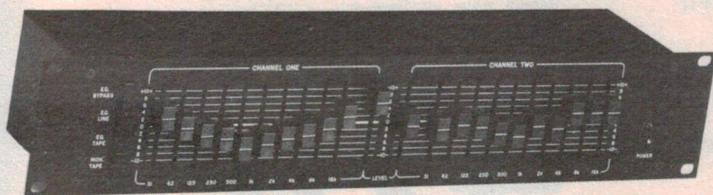
As a creative tool in sound recording or re-recording the 2801 allows complete freedom in contouring response over the complete audio spectrum from 31.5Hz to 16KHz.

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This model is distinct from the 2801, 2801 MK II. It features quality I.C. sockets for all I.C.'s as well as several component changes. ie: We are using 4136 op amps again because they draw less current than the TL075/85. This results in less hum radiation from the transformer. We are also using higher value slide pots, and a 5534 op amp for the line driver. Using the 5534 renders the output short circuit proof-handly when on the road.

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### 2010 MK II



The 2010 is a two channel graphic equaliser featuring ten adjustable controls on octave centre frequencies (independent for each channel). Each control provides up to -14dB of adjustment. Each channel is also equipped with a level match control giving an overall gain of adjustment of -14dB. The functional versatility of the 2010 equaliser is unsurpassed. Eight modes of operation are available from the push button switches on the front panel. Included amongst these are the ability to equalise both recording and playback when dubbing tapes. The 2010 has been designed to be compatible with all commercially available equipment and is ideal for use in a HI FI system or PA system

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### SPECIFICATIONS

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EQ LINE OR TAPE  
EQ BYPASS  
SIGNAL TO NOISE RATIO  
2 VOLTS OUT CONTROLS FLAT  
TOTAL HARMONIC DISTORTION  
1 VOLTS OUT CONTROLS FLAT  
RATED OUTPUT  
OUTPUT AT CLIPPING  
INPUT IMPEDANCE  
MAXIMUM INPUT VOLTAGE  
EQ CENTRE FREQUENCIES

+0.5dB 10Hz to 20KHz, Controls flat

Flat

Greater than 87dB

Less than .04 % 20Hz to 20KHz

100ohms

2 Volts RMS into 10K load

10 volts RMS

50K nominal

10 volts RMS

31, 62, 125, 500, 1K, 2K, 4K, 8K, 16K

Hz±10%

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WEIGHT

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+10dB

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Vertical Slide Control each Channel

Pushbutton Switch

Pushbutton Switch

Pushbutton Switch

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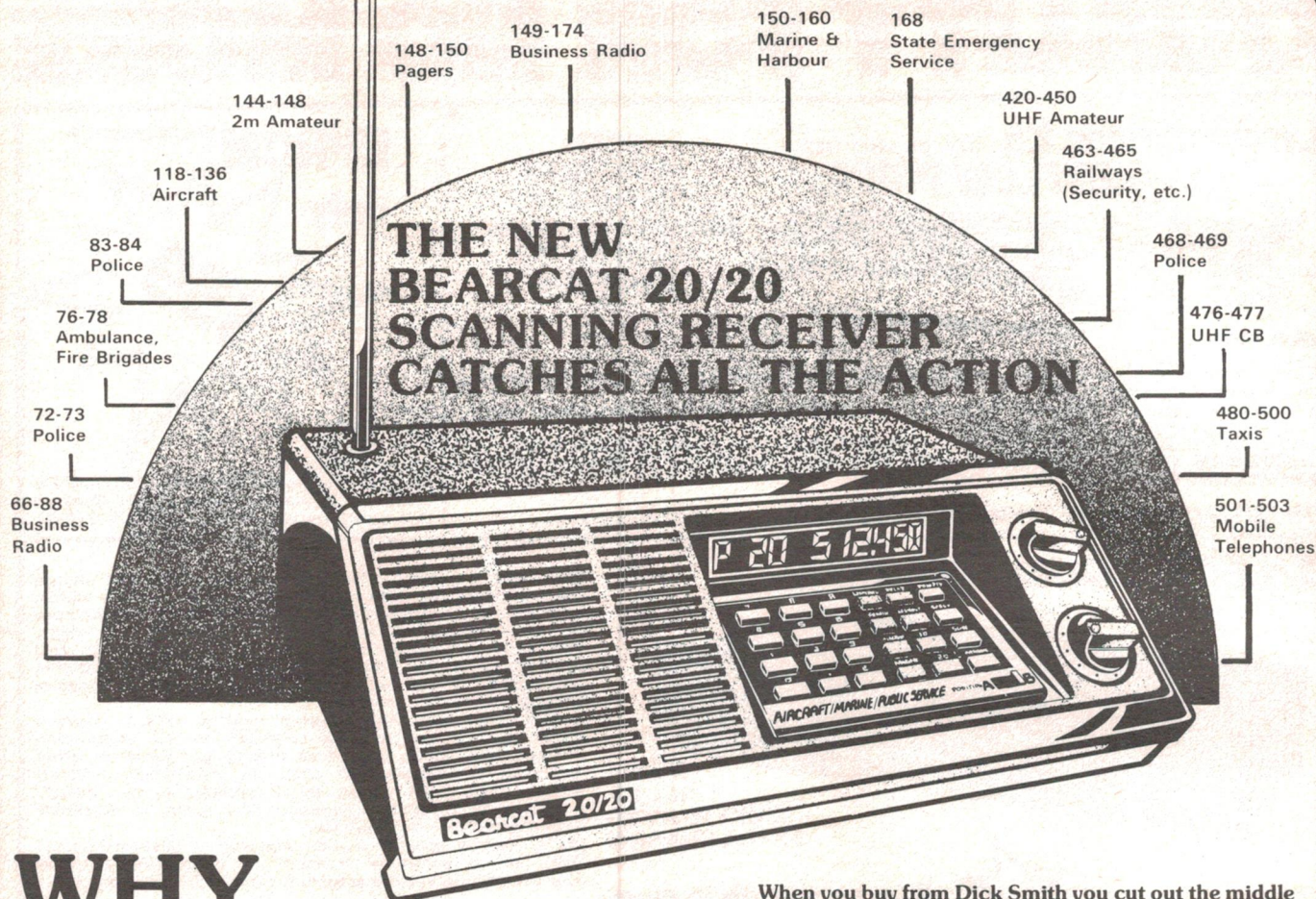
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ONLY

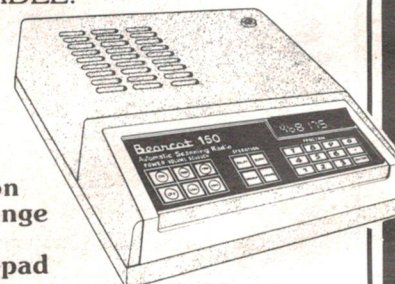
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Cat D-2810

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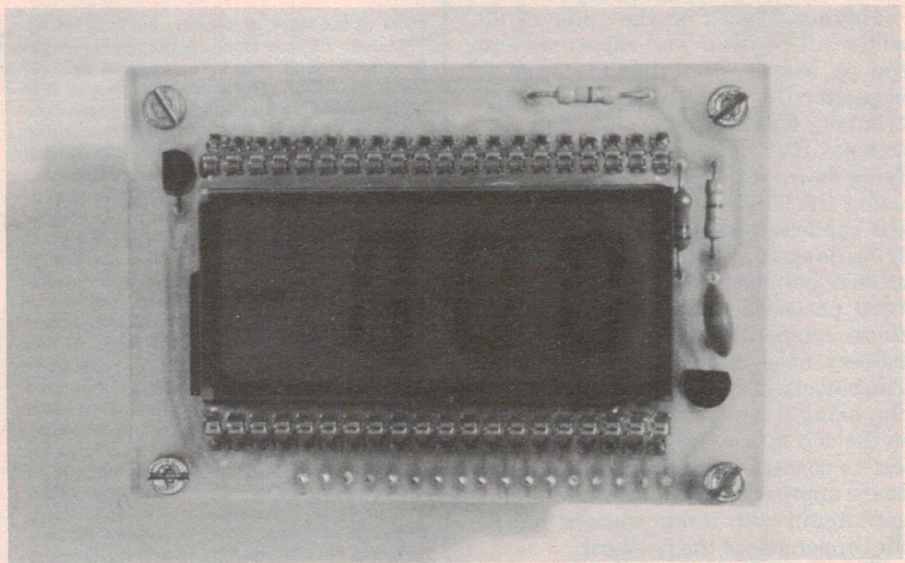
## Versatile digital panel meter with liquid crystal display

David Tilbrook

This simple, versatile project can be used as the basis of many test instruments or as a stand-alone meter to measure voltage (as low as 200 mV) or current.

THERE ARE many applications that require a digital readout of dc voltage. To fulfil this requirement we published a digital voltmeter, the ETI-135 digital panel meter in October 1977. It was based around the Intersil ICL7106 digital voltmeter IC, which was at that time available in the form of an evaluation kit. Although the individual ICs are widely distributed now the evaluation kits are becoming scarce. For this reason we have decided to republish the design in a form suitable for commonly available components. The kit was supplied with small rectangular capacitors enabling them to be laid on their side to reduce height and allow the display to be mounted as closely as possible to the front panel. Unfortunately these capacitors are not commonly available. Greencaps work well in this application but their physical size requires a new pc board layout.

We overcame these problems by designing a pc board suitable to be cut in half. The display, the 7106 IC and a few other components mount on one of the pc boards, while all other components, including the battery if required, mount on the other pc board. This enables almost any sized components to be used and by mounting one of the pc boards behind the other, ensures the display occupies as little front panel space as possible. ▶



### SPECIFICATIONS

Full scale readout	depends on setup. Full scale sensitivity is 199.9 mV
Resolution	100 $\mu$ V
Accuracy	< 1 digit when correctly calibrated
Display	3½-digit LCD
Input Impedance	> $10^{12}$ ohms
Input bias current	approx. 2 pA
Polarity indication	automatic
Conversion method	dual slope
Reference	internally generated $\pm 100$ ppm
Power supply	9 V @ approx. 1 mA



# Project 161

## Construction

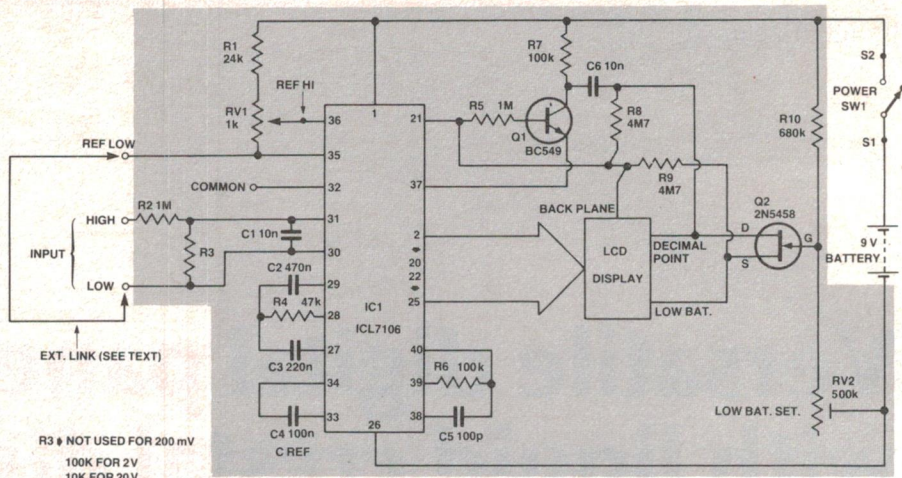
The project can be constructed in two forms, either on a single pc board, or as mentioned above, by cutting the pc board in half and mounting one half behind the other. If your application requires that the pc board be cut, do so before mounting any of the components.

Start construction by deciding on the sensitivity that best suits your requirements. This decides the value of resistor R3. If a 200 mV (199.9 mV) maximum sensitivity is required R3 is omitted. For a 2 V (1.999 V) meter, the required value of R3 is 100k while for a 20 V (19.99 V) meter, use 10k.

If the meter is setup for 200 mV operation it is advisable to solder an additional 1M resistor in parallel with the input, i.e: directly from the low input terminal to the high input terminal. This reduces the input impedance of the meter to 1M and reduces the sensitivity of the instrument to stray static voltages. Without this resistor the display has an input impedance of more than  $10^{12}$  ohms. So the input capacitance can easily become charged by static, prohibiting the meter from zeroing correctly. On the other ranges, a parallel resistor is automatically present so the additional 1M resistor is not necessary.

Having decided on the value of R3, solder all resistors and capacitors onto the pc boards, with the exception of capacitor C6. Next, solder the 10-turn trimpot, RV1, and the 'low batt.' set trimpot, RV2. The latter is best mounted lying down. If the project is constructed using the single pc board approach all the components should also be mounted lying down so that the display can be as close as possible to the front panel. If the twin pc board approach is used only those components mounted under the battery need be mounted lying down. The battery is mounted on a 9 V battery clip using 6 mm long spacers as shown in the accompanying photos. If the project is constructed using the single pc board approach, mount the battery clip, once again with 6 mm spacers, but on the copper side of the pc board.

The main IC and the liquid crystal display can now be mounted. The 7106 is mounted under the LCD display, so if a socket is required ensure that it is a low height type. Otherwise, solder the IC directly to the pc board making sure that the device has been inserted the right way around. Check this against the construction overlay before soldering. The LCD display should be mounted using Molex pins. This spaces the display off the pc board and ensures that the transistors and capacitors around the display are not higher than the dis-



PRINTED CIRCUIT ARTWORK for this project can be obtained by sending a stamped, self-addressed envelope to: ETI-161 ARTWORK, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

play itself. It is probably easier to plug in the display before soldering the remaining components. There are no convenient orientation marks on the display so it is necessary to hold it at a slight angle and look for the outline of the digits. The display should be mounted with the decimal points at the bottom and the 'LOW BAT' indicator in the top left hand corner of the display.

Finally, solder the remaining transistors and capacitor C3, being careful to orientate the transistors correctly and not to scratch the front glass of the display.

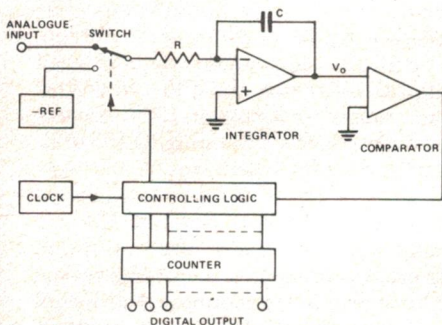
If the single pc board approach has been adopted, construction is complete at this stage. If the twin pc board approach has been used however, it is necessary to solder the 18 wire links

## HOW IT WORKS — ETI-161

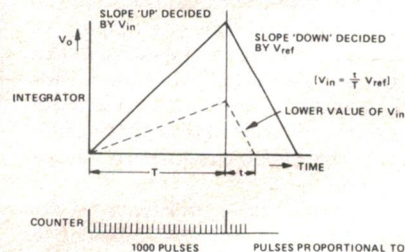
Most of the work is done by the ICL7106 IC. This uses the dual-slope integration technique to ensure good long-term accuracy and reliable operation. The analogue input is first converted to a time period which is then converted to a binary number by a digital counting system. This conversion system is illustrated in the block diagram. When the switch connects the analogue signal input to the input of the integrator, the output from the integrator ramps up at a rate determined by the input voltage. At the same time, the counter is started at zero and begins to count clock pulses. When a predetermined number of pulses has been counted the input is switched to the reference by the control logic. At this time, the integrator capacitor, C, has been charged linearly to some voltage determined by the ramp rate and therefore by the input voltage. As the switch changes to the reference, the counter is reset to zero and commences counting again. The reference is of appropriate polarity to that of the input signal and so causes the integrator to ramp down with a fixed slope. When the output reaches zero, the counter is stopped and its contents displayed on the digital readout. The count displayed is the ratio of the counts during the downward ramp to the counts during the upward ramp.

The value of the integrator capacitor and clock frequency are of little significance, provided they are stable for the duration of the conversion period.

This is a true dual polarity system so the integration direction depends on the polarity of the input voltage. Provided ac ripple on the input averages to zero over the count time it will be rejected. If 50 Hz ripple is to be rejected, for example, a 50 kHz clock rate could be used, giving an 80 ms sampling time (four cycles of 50 Hz). The clock can be adjusted by varying



Block diagram of the dual-slope integration technique

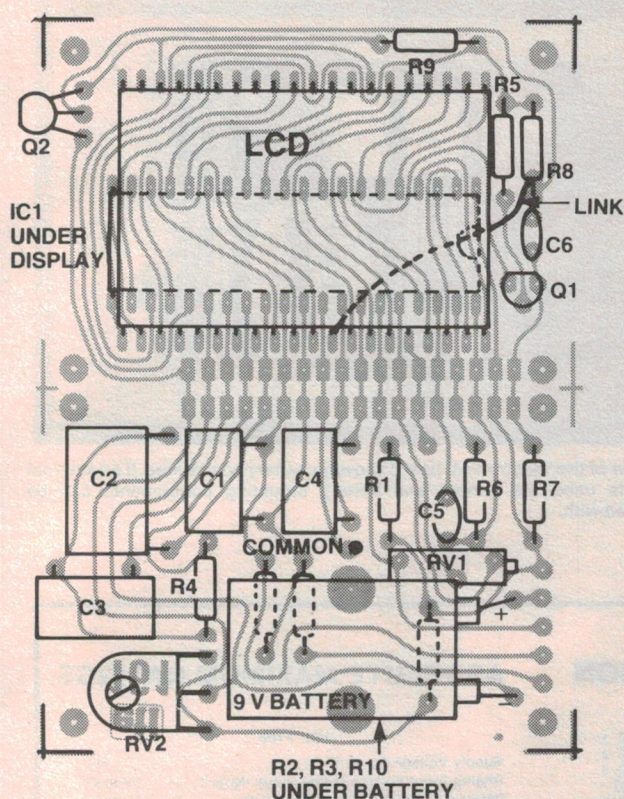


Timing diagram of the dual-slope A/D conversion technique.

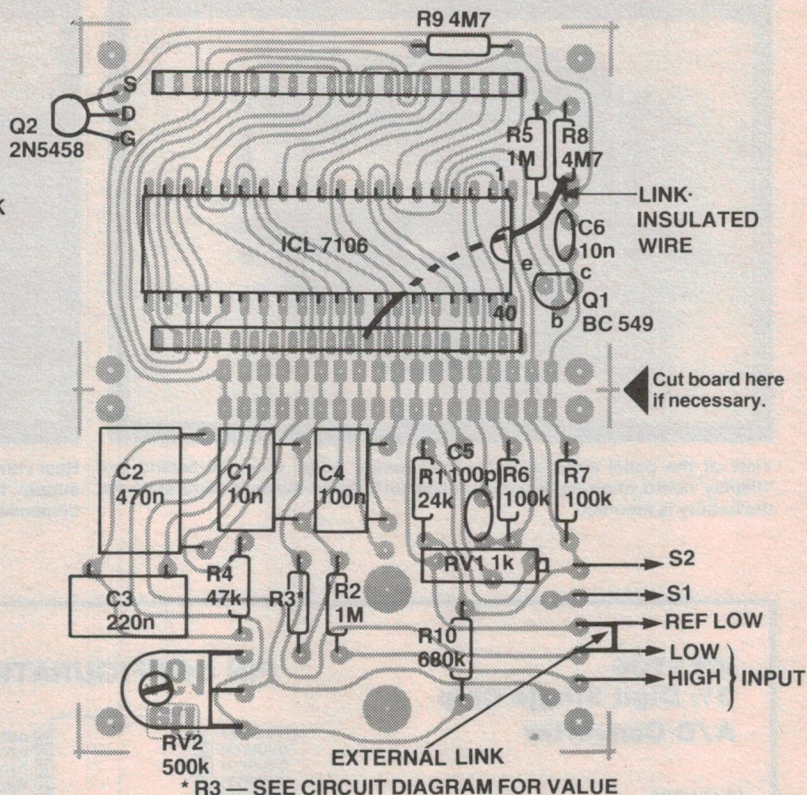
the value of R6. We experienced no problem with 50 Hz ripple. Capacitor C1 in conjunction with resistor R2 function as a low pass filter with a -3 dB rolloff point well below 50 Hz.

The 2N5458 JFET (Q2) is used simply as a voltage sensor to monitor the battery voltage and drive the LOW BAT indicator if the voltage falls below that determined during set up.





COMPONENT OVERLAY SHOWING POSITION OF LCD AND BATTERY



COMPONENT OVERLAY WITHOUT LCD OR BATTERY SHOWING POSITION OF IC, R2, R3 AND R10

between the two boards. Before doing this however, solder a lead from the point on the pc board marked 'COM.' It is necessary to connect this point to one of the two input terminals. The usual method is to connect COM to the low input. Also, connect REF LOW to the low input. This configures the meter to a normal absolute reading voltmeter that will display the voltage between the low and high input terminals with normal polarity indication. The module is also capable of ratiometric measurement. For information about this application consult the data sheet included for the ICL7106.

Mount the pc boards, spacing them approximately 20 mm apart, either using spacers or simply an entire set of nuts on the four mounting bolts. Use tinned copper wire to make the links between the pc boards, soldering each one at both ends before proceeding to the next. A fine-tipped soldering iron and fine solder (22g) should be used for this project and is especially important at this stage.

## Calibration

Before powering up, ensure that all components have been soldered correctly and have been inserted with the correct orientation. If all is well plug in the battery and connect the points S1 and

S2 to each other. The display should immediately stabilise with all digits reading zero. Use a power supply to generate a test voltage and adjust RV1 so that the panel meter agrees with another voltmeter. Preferably use a digital voltmeter for this, although a good analogue instrument can also be used with decreased accuracy. RV2 is used to adjust the low battery indication on the display. The best way to do this is to run the unit from an adjustable power supply, checking operation against a known voltmeter while decreasing the supply voltage. Set the LOW BAT indicator to come on at a supply voltage just above where the panel meter fails to read accurately. Do not exceed 9 V on the supply leads when doing this test.

Once calibrated correctly this project is capable of very accurate measurement. The 7106 is used in many commercial digital multimeters and the high input impedance enables the module to be used in many applications.

We intend publishing several projects using the display, but even as a general purpose dc voltmeter the module has proved very useful. A 1R shunt resistor can be soldered directly across the input to convert the module into a dc current meter reading in milliamps (i.e: 199.9 mA). Use an OR1 shunt to read dc amps (i.e: 1.999 A). Add an 'absolute

value' generator to enable ac voltage or current to be measured. ▶

## PARTS LIST — ETI-161

**Resistors** ..... all 1/4W, 5%  
 R1 ..... 24k  
 R2, R5 ..... 1M  
 R3 ..... see note  
 R4 ..... 47k  
 R6, R7 ..... 100k  
 R8, R9 ..... 4M7  
 R10 ..... 680k  
 RV1 ..... 1k 10-turn trimpot  
 RV2 ..... 500k horizontal trimpot

**Capacitors**  
 C1 ..... 10n mylar, 50 V  
 C2 ..... 470n mylar, 50 V  
 C3 ..... 220n mylar, 50 V  
 C4 ..... 100n mylar, 50 V  
 C5 ..... 100p NPO ceramic  
 C6 ..... 10n ceramic

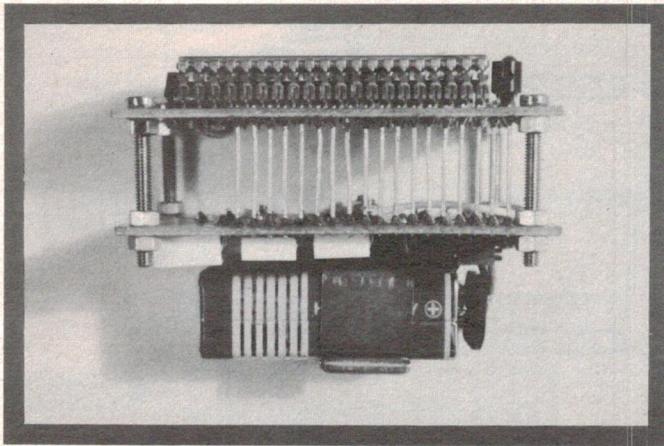
**Semiconductors**  
 IC1 ..... ICL7106  
 Q1 ..... BC549, BC109  
 Q2 ..... 2N5458, MPF106

**Miscellaneous**  
 ETI-161 pc board; LAD204 liquid crystal display (from Intersil evaluation kit) or similar; battery holder clip for No. 216 battery (if required); SW1 — SPST switch (if required); two 6 mm long spacers; four 20 mm spacers (if required); nuts and bolts to suit assembly; No. 216 9 V battery (if required).

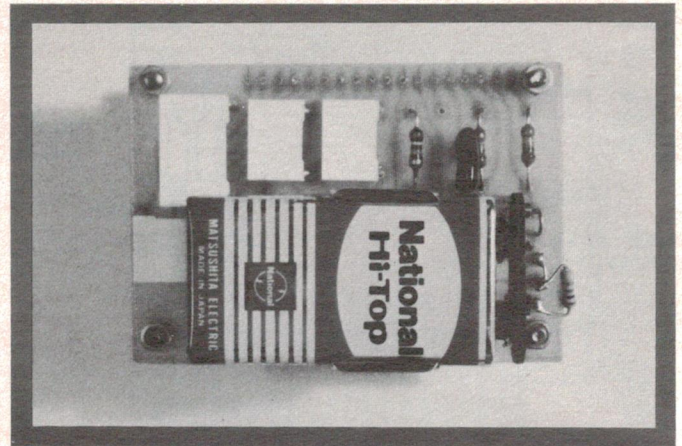
**Price estimate** ..... \$30 — \$35

NOTE: many of these components are available in the Intersil Evaluation kit, particularly the 7106, the display and the capacitors.





View of the panel meter with the 'electronics' board mounted behind the 'display' board, showing the connections run between the two boards and how the battery is mounted.



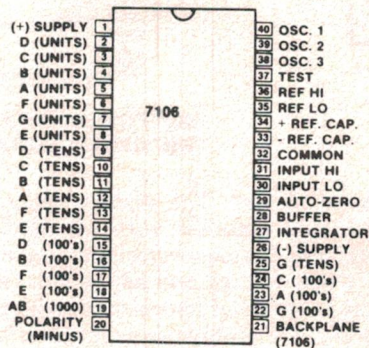
Rear view of the 'electronics' board showing battery positioning. If an external supply is used the battery and battery mounting components can be dispensed with.

## ICL7106 3½ Digit Single Chip A/D Converter

### FEATURES

- Guaranteed zero reading for 0 volts input on all scales.
- True polarity at zero for precise null detection.
- 1 pA input current typical.
- True differential input and reference.
- Direct display drive - no external components required. — LCD ICL7106  
— LED ICL7107
- Low noise - less than 15µV pk-pk.
- On-chip clock and reference.
- Low power dissipation - typically less than 10mW.

## PIN CONFIGURATION



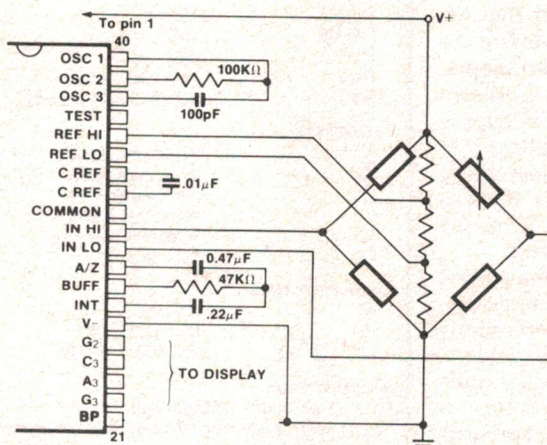
## ABSOLUTE MAXIMUM RATINGS

### ICL 7106

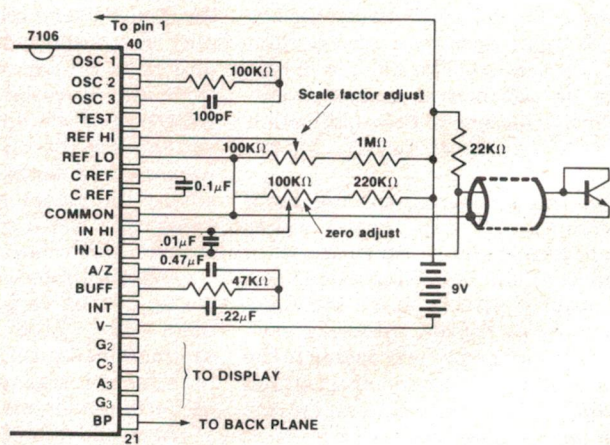
Supply Voltage (V+ to V-)	15V
Analog Input Voltage (either input) (Note 1)	V+ to V-
Reference Input Voltage (either input)	V+ to V-
Clock Input	Test to V+
Power Dissipation (Note 2)	
Ceramic Package	1000 mW
Plastic Package	800 mW
Operating Temperature	0°C to +70°C
Storage Temperature	-65°C to +160°C
Lead Temperature (Soldering, 60 sec)	300°C

Note 1: Input voltages may exceed the supply voltages provided the input current is limited to  $\pm 100\mu\text{A}$ .

Note 2: Dissipation rating assumes device is mounted with all leads soldered to printed circuit board.



7106 measuring ratiometric values of Quad Load Cell. The resistor values within the bridge are determined by the desired sensitivity.

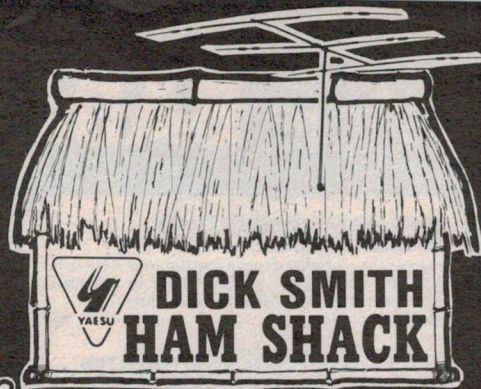


7106 used as a digital centigrade thermometer. A silicon diode-connected transistor has a temperature coefficient of about  $-2\text{mV}/^\circ\text{C}$ . Calibration is achieved by placing the sensing transistor in ice water and adjusting the zeroing potentiometer for a 000.0 reading. The sensor should then be placed in boiling water and the scale-factor potentiometer adjusted for 100.0 reading.



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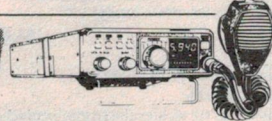
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(\*Option) General Coverage 150kHz - 30MHz



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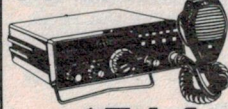
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bands — memory option Cat D-2853

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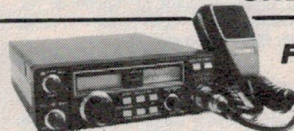
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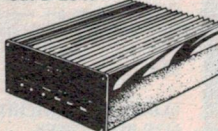
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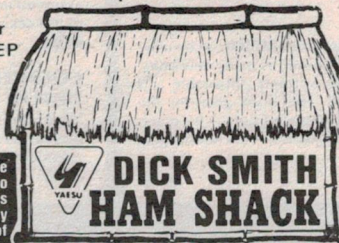
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Many interesting and useful projects — multivibrators, amplifiers and oscillators; trigger devices; special devices.

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## PRACTICAL INTRO TO DIGITAL ICs

Introduction to digital ICs (mainly TTL 7400). Besides simple projects, includes logic test set to identify and test digital ICs. Also includes digital counter-timer.

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Full practical constructional details of receivers with performance equal to commercial units. Also 'add-on' circuits of Q meter, S meter, noise limiter etc.

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## BEGINNERS' GUIDE TO BUILDING ELECTRONIC PROJECTS

Enables total beginners to tackle electronic projects. Includes component identification, tools, soldering, building methods, cases, legends etc. etc. Practical basic projects are included.

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Equivalents book for amateurs and servicemen. More than 18 000 old and new valves from UK, USA, Europe, Japan et al. CV (military) listings with commercial equivalents included.

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## FIRST BOOK OF PRACTICAL ELECTRONIC PROJECTS

Full constructional data, circuits, components lists for many practical projects including audio distortion meter, super FET receiver, guitar amp, metronome, etc.

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Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks! A steal at only...

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## 50 FET PROJECTS

Projects include amplifiers and converters, test equipment, tuners, receivers and receiver aids, mixers and tone controls etc etc. The FET used is not critical. This book is of interest and value to SW listeners, radio amateurs, hi-fi enthusiasts and general experimenters.

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One wonders how life went on before the 555! Included are basic and general circuits, motor car and model railway circuits, alarms and noise makers plus section on subsequent 556, 558 and 559s.

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## MOBILE DISCO HANDBOOK

Most people who start mobile discos know little about equipment or what to buy. This book assumes no preliminary knowledge and gives enough info to enable you to have a reasonable understanding of disco gear.

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## ELECTRONIC PROJECTS FOR BEGINNERS

This book gives the newcomer to electronics a wide range of easily built projects. Actual components and wiring layouts aid the beginner. Some of the projects may be built without using soldering techniques.

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## LM 3900 IC PROJECTS

Unlike conventional op-amps, the LM 3900 can be used for all the usual applications as well as many new ones. It's one of the most versatile, freely obtainable and inexpensive devices around. This book provides the groundwork for simple and advanced uses — it's much more than a collection of projects. Very thoroughly recommended.

BP50 \$4.95

## LONG DISTANCE TV RECEPTION (TV-DX)

Written by UK authority, the book includes many units and devices made by active enthusiasts. A practical and authoritative intro to this unusual aspect of electronics.

BP52 \$6.60

## PRACTICAL ELECTRONIC CALCULATIONS & FORMULAE

For the practical person's workbench. Bridges gap between technical theory and cut-and-dried methods which work but leave the experimenter unfulfilled. There's a strong practical bias. Tedious and higher maths avoided where possible. Many tables included. This one's a beauty!

BP53 \$8.25

## HOW TO BUILD YOUR OWN SOLID-STATE OSCILLOSCOPE

Project divided into sections for builder individually to construct and test — then assemble into complete instrument. Includes short section on scope usage.

BP57 \$5.50

## SECOND BOOK OF CMOS IC PROJECTS

Leading on from book number 224 '50 CMOS IC PROJECTS', this second book provides a further selection of useful circuits mainly of a fairly simple nature. Contents have been selected to ensure minimum overlap between the two books.

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## BEGINNER'S GUIDE TO DIGITAL ELECTRONICS

Covers all essential areas including number systems, codes, constructional and sequential logic, analog/digital/analog conversion.

BP61 \$3.50

## ELEMENTS OF ELECTRONICS

This series provides an inexpensive intro to modern electronics. Although written for readers with no more than basic arithmetic skills, maths is not avoided — all the maths is taught as the reader progresses.

The course concentrates on the understanding of concepts central to electronics, rather than continually digressing over the whole field. Once the fundamentals are learned the workings of most other things are soon revealed. The author anticipates where difficulties lie and guides the reader through them.

**BOOK 1 (BP62):** All fundamental theory necessary to full understanding of simple electronic circuits and components.

**BOOK 2 (BP63):** Alternating current theory.

**BOOK 3 (BP64):** Semiconductor technology leading to transistors and ICs.

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## SINGLE IC PROJECTS

Simple to build projects based on a single IC. A few projects use one or two transistors as well. A strip board layout is given for each project plus special constructional and setting up info. Contents include low level audio circuits, audio power amps, timers, op-amps and miscellaneous circuits.

BP65 \$5.10

## BEGINNER'S GUIDE TO MICROPROCESSORS & COMPUTING

Introduction to basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming. Only prior knowledge assumed is very basic arithmetic and an understanding of indices.

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Well-known author F.G. Rayer features applications and projects using various types of numerical displays, popular counter and driver ICs, etc.

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## 52 PROJECTS USING IC741

This book of projects using the inexpensive 741 integrated circuit is translated from the original highly popular German version, with copious notes, data and circuitry.

**BP24** \$3.50

## POPULAR ELECTRONIC PROJECTS

A collection of the most popular types of circuits and projects to interest most electronics constructors. The projects cover a wide range and are divided into four basic types: radio, audio, household and test equipment.

**BP49** \$4.95

## ELECTRONIC SECURITY DEVICES

Besides including both simple and more sophisticated burglar alarm circuits using light, infrared and ultrasonics, this book also gives circuits for gas and smoke detectors, flood alarms, fire alarms, doorphones, baby alarms, etc.

**BP56** \$5.35

## PRACTICAL CONSTRUCTION OF PREAMPS, TONE CONTROLS, FILTERS ATTENUATORS

This book shows the enthusiast how to construct a variety of magnetic tape recording, microphone and disc preamplifiers, and also a number of tone control circuits, rumble and scratch filters, attenuators and pads.

**BP60** \$5.30

## CHOOSING AND USING YOUR HI-FI

Provides fundamental info invaluable when buying hi-fi. Explains tech. specs, advice on minimum acceptable standards and specs for adequate sound. Also invaluable advice on how to buy and install and maximise your equipment's potential. Includes glossary of terms.

**BP68** \$6.10

## ELECTRONIC GAMES

How to build many interesting electronic games using modern ICs. Covers both simple and complex circuits for beginner and advanced builder alike. Good one!

**BP69** \$6.40

## ELECTRONIC HOUSEHOLD PROJECTS

Most useful and popular projects for use around the home. Includes two-tone buzzer, intercom, smoke and gas detectors, baby alarm, freezer alarm etc. etc.

**BP71** \$6.10

## A MICROPROCESSOR PRIMER

This small book takes the mystery out of microprocessors. It starts with a design for a simple computer described in language easy to learn and follow. The shortcomings of this basic machine are then discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions. An interesting and unusual approach.

**BP72** \$6.40

## REMOTE CONTROL PROJECTS

Covers radio, infra-red, visible light, ultrasonic controls. Full explanations are provided so that the reader can adapt the projects for domestic and industrial as well as model use.

**BP73** \$7.15

## ELECTRONIC MUSIC PROJECTS

Provides constructors with practical circuits for the less complex music equipment including fuzz box, waa-waa pedal, sustain unit, reverb and phaser, tremolo generator etc. Text covers guitar effects, general effects, sound generators, accessories.

**BP74** \$6.40

## ELECTRONIC TEST EQUIPMENT CONSTRUCTION

Describes construction of wide range of test gear including FET amplified voltmeter, resistance bridge, field strength indicator, heterodyne frequency meter etc.

**BP75** \$6.40

## TRANSISTOR RADIO FAULT-FINDING CHART

Used properly, this chart should enable the reader to trace most common faults quickly. Across the top of the chart are four rectangles containing brief descriptions of these faults: sound weak but undistorted; set dead; sound low and distorted; background noises. Selecting the appropriate fault, the reader simply follows the arrows and carries out the suggested checks in sequence until the fault is cleared.

**BP70** \$1.85

## ELECTRONIC CALCULATOR USERS' HANDBOOK

Presents formulae, data, methods of calculation, conversion factors, etc. for use with the simplest or most sophisticated calculators. Includes the way to calculate using only a simple four-function calculator: trigonometric functions (sin, cos, tan); hyperbolic functions (sinh, cosh, tanh); logarithms, square roots and powers.

**BP33** \$4.60

## LINEAR IC EQUIVALENTS AND PIN CONNECTIONS

Shows equivalents and pin connections of a selection of popular linear ICs, with details of families, functions, country of origin and manufacture. Includes devices from Analog Devices, Advance Micro Devices, Fairchild, Harris, ITT, Motorola, Philips, RCA, Raytheon, Signetics, Sescocem, SGS-ATES, Siemens, AEG-Telefunken, Teledyne, Texas Instruments.

**BP41** \$10.00

## ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST

Knowledge of a subject considerably increases the enjoyment and satisfaction derived from its practice, and the object of this book is to supply the electronics hobbyist with a background knowledge tailor-made for his or her specific requirements. Minimum maths!

**228** \$4.60

## PRACTICAL COMPUTER EXPERIMENTS

How to build typical computer circuits using discrete logic. This book is useful intro to devices such as adders and storers as well as a general source book of logic circuits.

**BP78** \$6.50

## RADIO CONTROL FOR BEGINNERS

How complete systems work with constructional details of solid state transmitters and receivers. Also included — antennas, field strength meter, crystal controlled superhet, electro-mechanical controls. Ideal for beginners. Section dealing with licensing etc. not applicable to Australia.

**BP79** \$6.40

## POPULAR ELECTRONIC CIRCUITS — BOOK 1

Yet more circuits from Mr Penfold! Includes audio, radio, test gear, music projects, household projects and many more. An extremely useful book for all hobbyists, offering remarkable value for the designs it contains.

**BP80** \$7.15

## ELECTRONIC SYNTHESISER PROJECTS

For the electronic music enthusiast, an invaluable reference. This book is full of circuits and information on how to build analogue delay lines, sequencers, VCOs, envelope shapers, etc. etc. The author takes a clear and logical approach to the subject that should enable the average enthusiast to understand and build up what appears to be a quite complex instrument.

**BP81** \$6.45

## ELECTRONIC PROJECTS USING SOLAR CELLS

Well-known author Owen Bishop has designed a number of projects that benefit from solar power and obviate the problems encountered with batteries, such as weight and bulk, frequency of replacement, and failure when batteries are exhausted.

**BP82** \$7.15

## VMOS PROJECTS

A book to suit the dyed-in-the-wool experimenter. Though primarily concerned with VMOS power FETs and their applications, power MOSFETs are dealt with, too, in a chapter on audio circuits. A number of varied and interesting projects is covered under the headings: Audio Circuits, Sound Generator Circuits, DC Control Circuits and Signal Circuits. Learn while you build.

**BP83** \$7.20

## DIGITAL IC PROJECTS

Companion to No. 225 Practical Introduction to Digital ICs and BP61 Beginner's Guide to Digital Electronics. The projects included in this book range from simple to more advanced projects — some board layouts and wiring diagrams are included. The more ambitious projects have been designed to be built and tested section by section to help the constructor avoid or correct any faults that may occur.

**BP84** \$7.20

## INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE

Companion to BP1 and BP14 equivalents books, but contains a huge amount of information on modern transistors produced by over 100 manufacturers. Wherever possible, equivalents are subdivided into European, American and Japanese types. Also shown are the material type, polarity, manufacturer and indication of use or application.

**BP85** \$10.85

## AN INTRO TO BASIC PROGRAMMING TECHNIQUES

Ideal for beginners seeking to understand and program in BASIC. Book includes program library for biorhythms, graphing Y against X, standard deviations, regressions, generating musical note sequences, and a card game.

**BP86** \$6.60

## SIMPLE LED CIRCUITS — BOOK 2

Sequel to BP42. Further light-emitting diode circuits. If you liked BP42 you'll love this one. If you don't know either it's well worth buying both!

**BP87** \$5.05

## ELECTRONIC CIRCUITS FOR MODEL RAILWAYS

Constructional details of a simple model train controller, a controller with simulated inertia, a high-power controller, an electronic steam whistle and a 'chuff generator'. Signal systems and train lighting and RF suppression also covered.

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# SAVE A FORTUNE: BUILD IT YOURSELF FROM A DICK SMITH KIT!

Why pay for commercial equipment when, with just a few hours of your time, you can build it yourself with the aid of a Dick Smith kit. Because you supply the labour, you can save \$\$\$! AND what's more, it's great fun. So have a go and do it yourself. Your friends will never believe you built it!

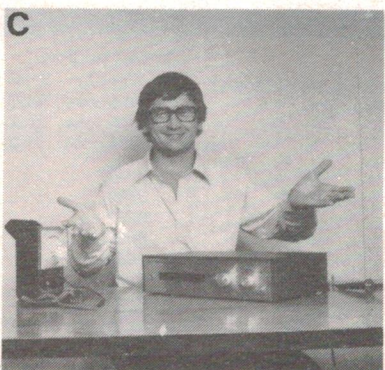
## Building a Dick Smith Kit is as easy as A B C!



Everything you need is supplied — parts, solder, even nuts and bolts. AND most kits include detailed instruction manuals, making construction a breeze!



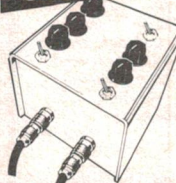
It goes together so easily; you don't have to be an expert to build a kit, just follow the instructions.



And it's finished! Sit back and enjoy your project: because you did it yourself!

**And it looks so good your friends won't believe you built it!**

**SAVE \$\$\$**



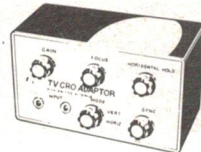
### DUAL TRACE CRO SWITCH

SAVE MONEY and convert your single trace CRO to a dual trace with this superb kit. Dual trace CRO's have uses in almost every application. Whenever you need to compare two waveforms, the dual trace CRO is the best bet. Cat K-3065. SEE EA FEB 81.

only **\$49<sup>00</sup>**  
WAS **\$55.00!**

### TV CRO ADAPTOR

Want to save a heap of money? If your electronic enthusiasm is hindered by financial burdens, this could be the kit for you. The TV CRO converts any standard TV set into a large screen oscilloscope with a frequency response from 10Hz to 300kHz with a sensitivity of 100 mV RMS for full screen deflection. Cat K-3060. SEE EA MAY 80.



only **\$29<sup>95</sup>**

### UNIVERSAL TIME/STOPWATCH

This terrific all-purpose counter can be used as a stopwatch, countdown timer or event timer. Large LED display, and timing rates are switch selectable between 0.01 secs to 1 sec. Great for sporting events, darkrooms - in fact anywhere you need to keep track of the time. Cat K-3435. SEE EA SEPT. 81.



only **\$39<sup>50</sup>**

### 240V CONTROL TIMER

Switch an appliance on for a preset period any time of night or day. Large lighted LCD clock and tough die cast case combine to give rugged reliability. Far more accurate than time switches enables time on period to be switched to 16, 32, 64 & 128 minutes. Cat K-3085. SEE EA APRIL 80.

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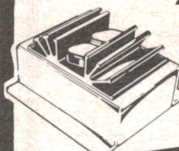
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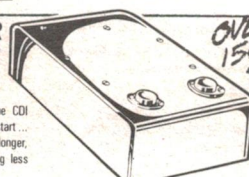
This kit incorporates circuitry with dwell extension which results in a hotter spark at high engine speeds and is compatible with modern electronic tachometers. All components and casing are supplied. Cat K-3300. SEE EA NOVEMBER 79.



only **\$29<sup>00</sup>**  
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### CAPACITOR DISCHARGE IGNITION

This has got to be the best value CDI available. Your car will be easier to start... when cold or hot, your plugs will last longer, keeping your car in time and using less petrol. Cat K-3280.



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OVER 15000 SOLD!

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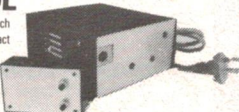
Protect your property and equipment with this ideal burglar alarm. A light beam trigger that uses an invisible beam of light! It has a range of 5m and there are no lenses to adjust. Battery power gives the unit about 50 hours continuous use. Cat K-3380. SEE ETI MAY 81.



only **\$59<sup>00</sup>**  
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### INFRARED 2-CHANNEL REMOTE CONTROL

Control 2 appliances simultaneously, independent of each other. Use it to control your alarms, stereo, radio, in fact just about anything you can think of. Cat K-3375. SEE EA APRIL 81.

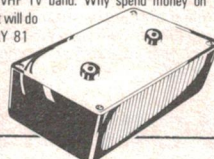


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### UHF/VHF DOWN CONVERTER

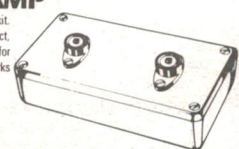
SINGLE CHANNEL ONLY. This project will convert TV station transmissions in the UHF band down to unoccupied channels in the VHF TV band. Why spend money on expensive TV sets fitted with UHF when this kit will do the job just as well. Cat K-3235. SEE EA MAY 81.



**\$29<sup>50</sup>**  
WAS **\$33.50**

### TV MASTHEAD AMP

Improve your TV reception with this easy to build kit. Can cut out 'snow' effect, reduce 'ghosting' effect, good for picking up distant stations and can be used for boosting FM signal as well, plus lots more! Works from 240V supply included. Cat K-3232. SEE EA AUGUST 79.



only **\$33<sup>50</sup>**

**SAVE \$\$\$**

### DIGITAL FREQUENCY COUNTER

Now a completely new frequency and period counter using the latest IC technology. Low component count makes it very easy to build and very reliable. It rivals the performance of commercial units costing many times the price. Cat K-3439. SEE EA DEC 81.



The case shown here is an option  
only **\$99<sup>50</sup>**

### FUNCTION GENERATOR

This kit produces sine/triangle and square waves over a frequency range from below 20Hz to over 160KHz! It has four digit LED readout enabling accurate frequency settings. The kit makes an ideal companion to our Frequency Counter Kit (Cat K-3439). The case shown here is an option (Cat H-2505 \$19.95) Cat K-3520.



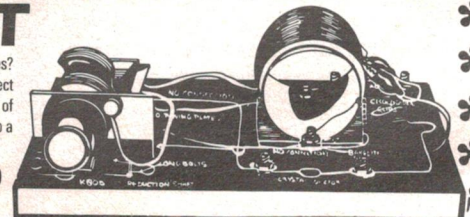
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SEE EA APRIL 82

## \* \* \* \* \* DICK'S ORIGINAL 1952 CRYSTAL SET \* \* \* \* \*

Want a radio that works during blackouts and doesn't need batteries? Then this is just for you! Dick's own crystal set kit. A satisfying project that will give you lots of fun. It can pull in a surprising number of broadcast stations and produce good sound even when connected to a stereo system. All necessary parts are supplied. Cat K-2650. SEE EA APRIL 82.

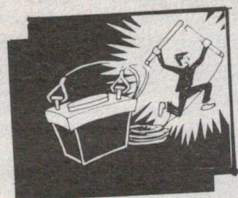
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**NEW KITS ... STOP PRESS ... NEW KITS ... STOP**

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### 12V FLUORO INVERTER

Handy project which should have appeal, with our impending power strikes. 12V operated inverter circuit in our CDI metal case! Also the power to drive 2 x 20watt or 1 x 40watt fluorescent tube (tube or container not supplied). Efficient circuit gives low current drain.

Cat K-3275

**ONLY  
\$65<sup>00</sup>**



### PROTOTYPER

Invaluable for Designers Experimenters, Hobbyists, useful for school projects, great as a teaching aid - Includes: Oscillator, led drivers, switches, debounce circuit all on-board. This safe unit has a separate power supply. The power supply can be varied or fixed. 5V and 1.25V to 10V. It has easy connector strip - every workshop should have one.

Cat.K-3465

**ONLY  
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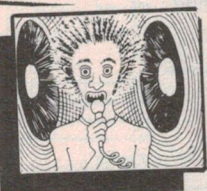


### POWER SUPPLY

This very useful Power Supply Kit is designed for use with high powered transceivers or where several small C.B.'s have to run from the one supply. Output voltage is 13.8 volts (fully regulated) at 7.5 amps continuous or 10 amps peaks. The supply is housed in a sturdy case, overload protector being provided by a Darlington Pair (current limiting) with led overload condition indication.

Cat K-3452

**ONLY  
\$119**



### 150watt PA AMPLIFIER

This fabulous little PA kit allows you to let more people hear you at your Rallies or if you're in to bigger things like Fete's we would all agree that this kit would save you heaps. It features: 2 mic inputs, 1 aux input, also Pre-amp out and insert facilities - when used with OP590 output transformer the applications are limitless. e.g. 2ohm, 4ohm, 8ohm, 16ohm, 50ohm (70v), or 100ohm (100v). Cat.K-3525. Transformer to suit MO153.

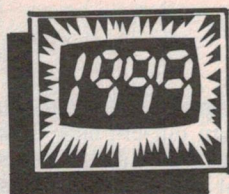
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### LCD DIGITAL PANEL METER

A versatile highly accurate panel meter using a large liquid crystal display for low power consumption. The PC board design allows for maximum flexibility to cater for varied mounting arrangements. The low cost makes it ideally suited as a readout device on many projects, at both amateur and professional level. It may be considered as a viable replacement to conventional existing analogue equipment.

Cat. K-3450

**ONLY  
\$29<sup>50</sup>**



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## PRICE SLASH PLUS A BONUS

Due to overordering we now have an excess of PCB's! So why not buy now while we're offering them at these ridiculously low prices. **You reap the benefit!** PLUS All boards bought after the 1st of August will include a copy of the EA or ETI article relating to that particular PCB.

Cat No.	Kit	Price			
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H-8366	Metal locator	\$1.10	H-8421	Voice operated relay	\$1.50
H-8377	Power chopper	\$1.00			
H-8384	Selectalot	\$1.50	H-8613	Car alarm	\$1.30
H-8387	Cylon voice	\$1.20	H-8638	Uni relay driver	\$1.40
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Ultrasonic transducers as used in the EA Electronic Rule kit. Cat No's L-7050 & L-7052 ... **ONLY \$4.95**  
Panel meter moving iron as used in EA Mains Watt Meter Kit. Cat No. Q-2090 ... **ONLY \$7.95**

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SUPER 80 COMPUTER - SEE EA AUG 81 (Cat K-3600)

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DIGITAL FREQUENCY COUNTER - See EA Dec 81 (Cat K-3493)  
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(above case is also used in function generator & new car computer)  
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FUNCTION GENERATOR - See EA April 82 (Cat K-3520)  
FND500 LED displays ... Cat Z-4150 ... \$1.35  
XR2206 IC ... Cat Z-6820 ... \$6.95  
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2SJ49 FET ... Cat Z-1816 ... \$7.90  
PCB ... Cat H-8644 ... \$6.50  
(PCB for mosfet amp preamplifier) ... Cat H-8646 ... \$6.50  
NE5534 IC ... Cat Z6090 ... \$4.50

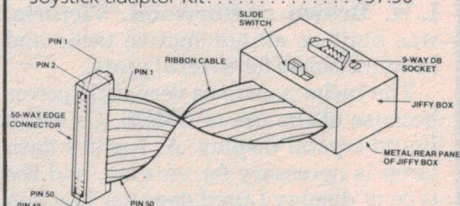
### SYSTEM-80 JOYSTICK ADAPTER KIT

Ever wish you could hook up a joystick to your System-80, so you could play games faster and with greater realism? Well, your wish has been answered. This little adapter won't strain your piggy bank and can be assembled very easily. It plugs in, and away you go!

NOTE: Compatible with most U.S. games software designed to work with the "Alpha" joystick.

Cat. K-3455

Joystick adaptor Kit. ... \$37.50



### MATCHING JOYSTICK

This is the joystick to go with the above adapter. Standard Atari-type joystick, with sensors for four primary directions of motion and separate "fire" button. Complete with cable and DB-09 connector. (Also suit VIC-20 computer).

Cat. X-2020 ... \$19.90



# DICK SMITH ELECTRONICS

**SEE PAGE 144  
FOR ADDRESSDETAILS**



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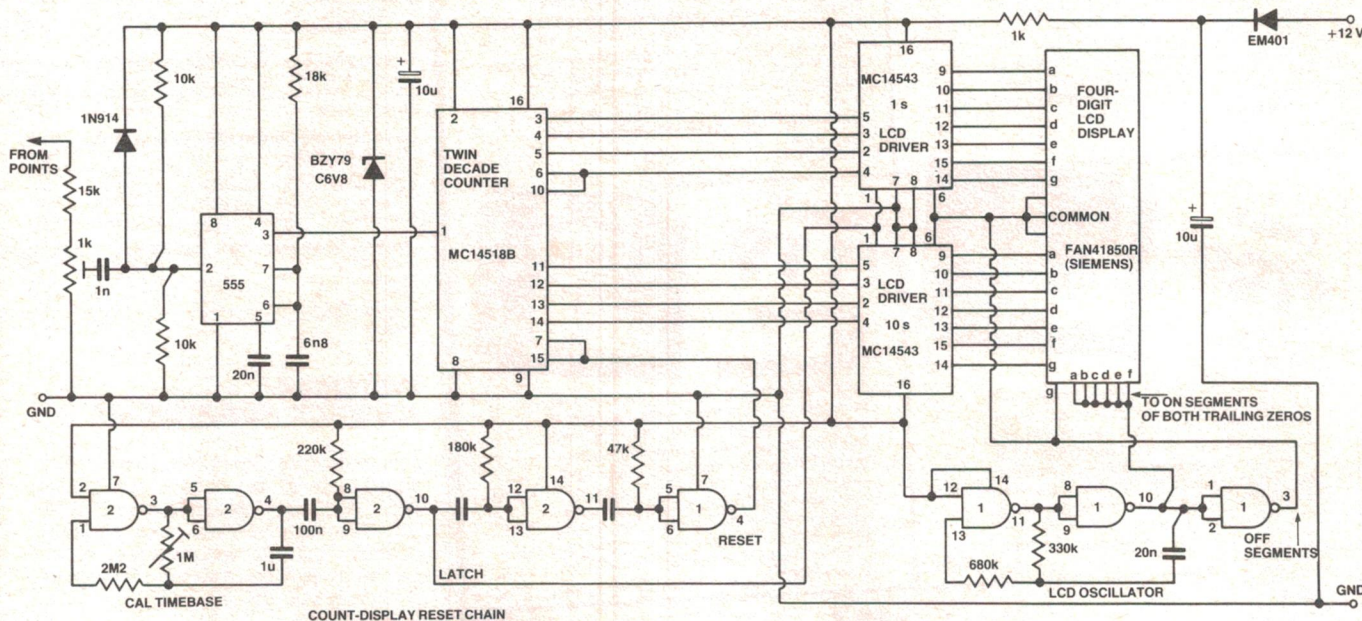
**DICK SMITH  
Quality Kits**





# Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



## LCD tachometer

This rev counter circuit, sent to us by **L.W. Brown of Burwood, Victoria**, was built as an automotive tachometer and has functioned for several years.

The tachometer consumes very little power because of the use of CMOS ICs and a liquid crystal display. At night a dash lamp is necessary for viewing, and the type of display I used does not function in extreme heat, nor did it work completely on frosty mornings, so it may be preferred to use a display with a wider temperature specification.

I used a display featuring a single edge connector, and the pc board was built the same size as this display-plus-edge connector. A very compact module of approximately 77 x 44 x 24 mm was constructed by mounting the pc board behind the display.

The circuit uses a conventional 555-type tachometer stage, driving two decade counters. Each decade counter drives a latch decoder driver and then the display. A 60 Hz square wave oscillator supplies the ac drive to the LCD and to the drivers. As this is a four-digit display reading directly in rpm, the two trailing digits are fixed at zero. These

'on' segments of the display are driven with an out-of-phase signal, while the 'off' segments are driven with the same signal as the common terminal.

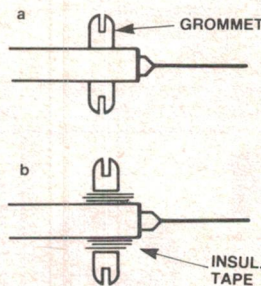
The timebase provides the necessary gating for counting by generating the display latch followed by the counter reset signal. The gate times required for a four-stroke engine are:

- 0.3 s for four cylinders
- 0.2 s for six cylinders
- 0.15 s for eight cylinders.

For a single cylinder two stroke engine the gate time is 0.6 s.

If a dc supply is not available, try connecting a 10k resistor from the points to the 12 V input. I have not tried this 'self power' modification, however.

## Probe finger guards



ETI's gripe about multimeter probes lacking finger guards in the Univolt multimeters review in the May issue (page 22) brought a swift response from **K.L. Blaze of the School of Botany, University of Melbourne, Victoria**. Here's how he solved the problem:

I use rubber grommets (e.g. from Clark Rubber stores, which stock a variety of sizes). These are slid onto the probe stems and, if necessary, glued in place — as shown in diagram (a). If the probe is too slim for the grommet, a few turns of insulating tape should suffice to enlarge the diameter — as in (b).



# SUB-WOOFER SYSTEM

## MASSIVE PRICE BREAKTHROUGH!!!

A Sub-Woofer System makes a lot of sense. Apart from getting down to a genuine 30Hz you could actually save money over all. For years we have been persevering with huge 12" 3 or 4 way systems in up to 120 litre cabinets to try to get down to— at best 45Hz. We have even duplicated our effort by having a stereo pair for this frequency!!!

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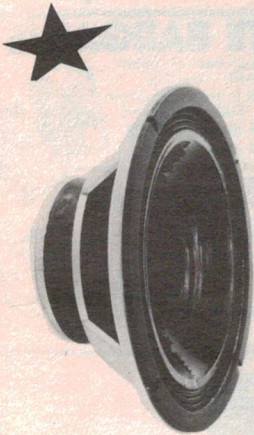
1812 LIKE NEVER BEFORE. So too those big pipe organ records. This system is a must for the direct or digital disk enthusiast.

Now that "ELECTRONICS AUSTRALIA" have designed \*a Mosfet Sub-Woofer filter/amplifier and speaker system you have no excuse.

JAYCARS' BULK BUYING PASSES SAVINGS ONTO YOU. TRULY A PRICE BREAKTHROUGH FOR SUB-WOOFER SYSTEMS.

\*(With due respect to Thiele, Small, Snyder and others!)

### THE SUB-WOOFER



This unit has been extremely popular with audio enthusiasts right across Australia! EA have designed a special crossover/booster amp just for this unit. Now you have no excuse to build a subwoofer system to enjoy those thrilling low notes from pipe organs, synthesisers, 1812 cannons etc!!

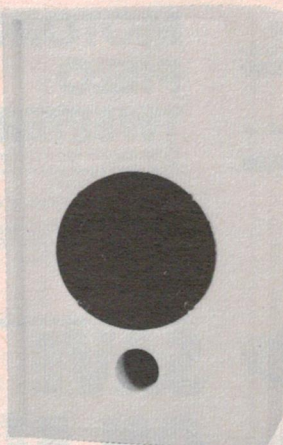
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MODEL SW 250

### THE ENCLOSURE \* \* \* \*



This compact 63 litre vented enclosure was specifically designed around the parameters of the SW 250 Sub-Woofer. It follows the theory pioneered by the work of Thiele, Small and Snyder. The Jaycar enclosure is easy to build and is made of high quality durable materials. The heavy walled cabinet is covered with an attractive black vinyl veneer. All timber is pre-cut and the black grille is already made. Assembly takes less than one hour.

NB. The photograph shows the prototype which was finished in white. The production units are only available in black.

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Ref. EA JULY 1982

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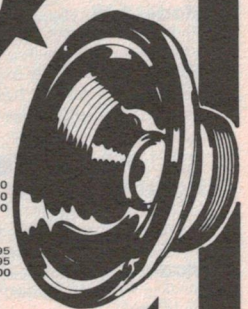
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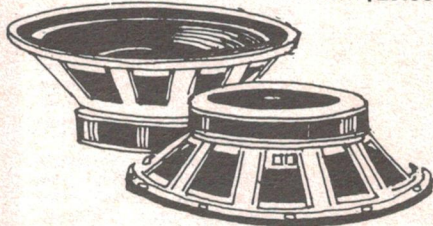


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**Model 145.** Ultra high power (120WRMS) woofer with high efficiency. Ideal for disco and other sound systems where power handling and efficiency are crucial. 25-4,000Hz response. **\$70.00**

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**Model 516.** Twin cone version of Model 511. Power handling 40WRMS. Frequency response 50-14,000Hz. **\$46.00**

**Model 231.** Similar to the 511 but higher power handling (60WRMS). Response 50-8,000Hz. Ideal for PA, Disco, musical instrument use. **\$52.00**

**Model 241.** General purpose high powered PA speaker. 80WRMS power handling. 50-8,000Hz response. **\$73.00**

**Model 246.** Twin cone wide range version of Model 241. 80WRMS power handling. 50-15,000Hz response. **\$77.00**

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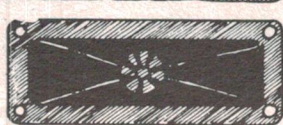
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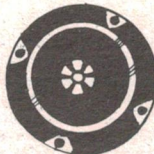


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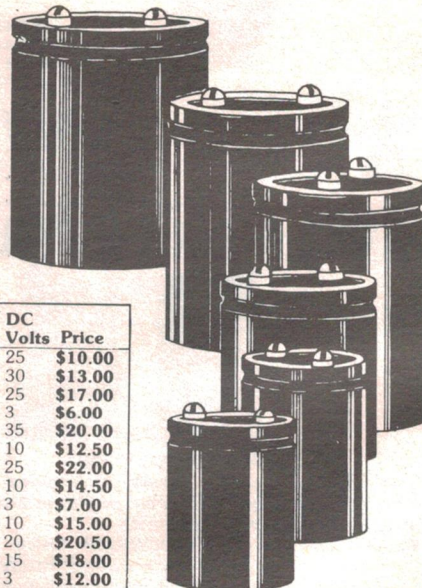
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2400	50	\$4.00	13000	60	\$10.00	55000	3	\$6.00
3000	75	\$5.00	14000	25	\$5.50	65000	35	\$20.00
3300	75	\$5.50	14000	40	\$9.00	67000	10	\$12.50
3600	25	\$3.25	15000	3	\$3.50	76000	25	\$22.00
3700	30	\$3.50	20000	25	\$8.75	88000	10	\$14.50
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# Ideas for Experimenters

## IDEA OF THE MONTH

★ Gary Brunkhorst  
McDowall, Qld. ★

## Symmetrical divide-by-three

This circuit takes an input (symmetrical) square wave at CMOS levels and divides it by a factor of three, producing a symmetrical output. Figure 1 shows input and output waveforms.

At first glance, this may seem a simple task, but note that the output waveform first changes state on a negative-going transition of the input waveform, then on a positive-going transition, etc. The circuit of Figure 2 neatly overcomes the problem of non-symmetrical divided output by inverting the input waveform periodically, using an exclusive-OR gate.

The waveforms involved are shown in Figure 3. The prototype circuit used a 74C73 for flipflop 1 and 2, but almost any type of edge-triggered flipflop could be used. The same method could be used to obtain a divide-by-5, 7 or 9.

(Ed. note: this circuit may not work at high speeds owing to gate delays in flipflops 1 and 2, but is nonetheless a good idea, despite the limitations.)

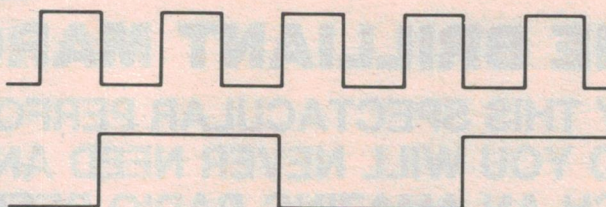


Figure 1

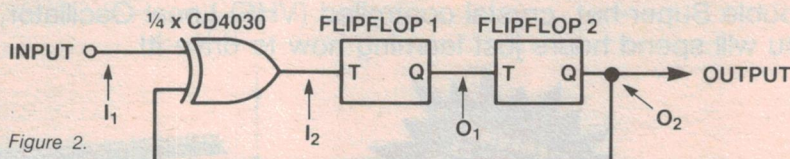


Figure 2.

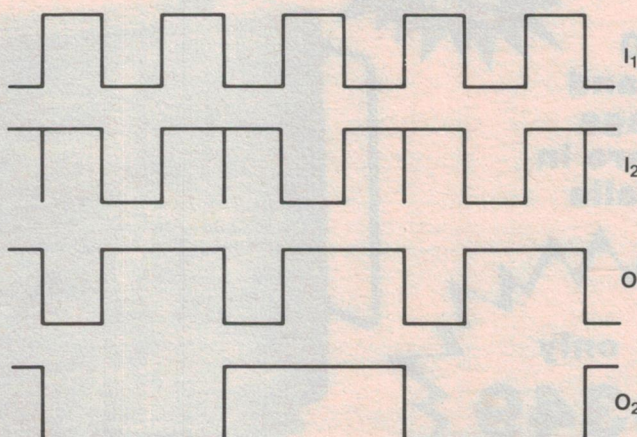


Figure 3.

## ★ 'IDEA OF THE MONTH' CONTEST ★

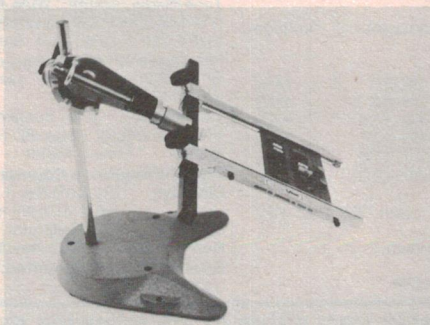
Scope Laboratories, who manufacture and distribute soldering irons and accessory tools, have offered to sponsor a contest with a prize to be given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI. Each month we will be giving away a Scope Panavise pc board holder, model 333 — as described in News Digest, p.8, October '81 issue. Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, worth about \$70, each winner will be paid \$10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

### RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Scope Laboratories, Murray Publishing, Offset Alpine, Australian Consolidated Press and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding the decision.



Winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI.

Contestants must enter their names and address where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

### COUPON

"I agree to the above terms and grant Electronics Today International all rights to publish my idea in ETI Magazine or other publications produced by them. I declare that the attached idea is my own original material, that it has not previously been published and that its publication does not violate any other copyright."

\* Breach of copyright is now a criminal offence.

Title of idea .....

Signature .....

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SW2	3.8-9	MHz	VHF4	108-136	MHz
SW3	9-22	MHz	VHF5	144-176	MHz
SW4	22-30	MHz	UHF	430-470	MHz

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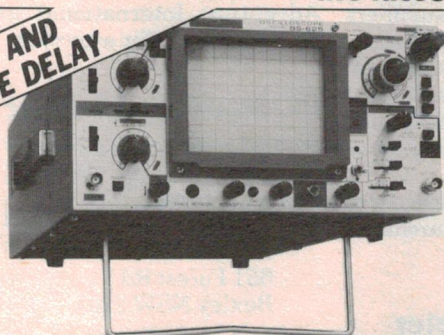


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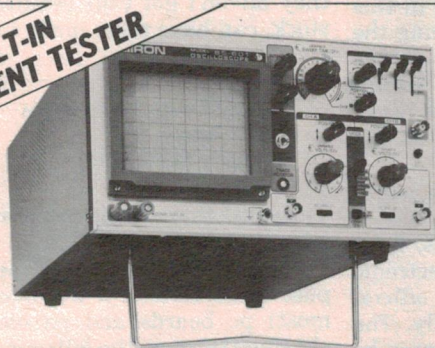


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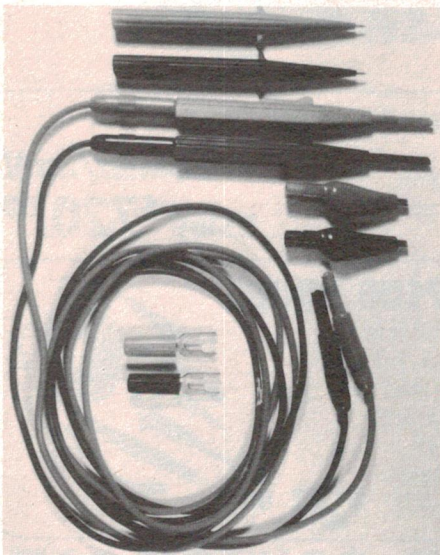
# Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

## ETI-1505 fluorescent light inverter

We had some difficulty sourcing suitable components with the characteristics required for this project, but following extensive discussions with the Philips organisation and one of their distributors, Sycom, supplies of both the EC-type ferrite cores and the BDY91 transistors should be available — albeit with a short delay in some instances.

The only retailer we could find who had current stocks of the specified Philips EC assemblies was All Electronic Components in Melbourne. They should also be able to supply BDY91 or BDY92 transistors. But, save yourself the trouble of collecting components, they have indicated they will be stocking a kit for this project.



Our gripe about multimeter leads in the May issue review of the Univolt multimeters (page 22) brought a swift response from Elmeasco. They distribute the Coline range of meter probes and accessories — said probes including finger guards, the lack of which was the subject of our gripe. The above photo shows the Coline set of probes that also include shrouded plugs, banana connectors and alligator clips. Clip-type and pointed probes are included; they just plug in to the leads. Cost? — just \$25 plus 17½% sales tax. Enquiries to Elmeasco, P.O. Box 30, Concord NSW 2137. (02)736-2888.

Many kits and component suppliers have indicated they will be stocking kits for this, but they may not be immediately available until adequate stocks of the Philips components arrive, which should be toward the end of the month or early in September.

The 'Safe-T-Lite' housings we used for our two 20 W tubes were purchased from Warburton Franki.

## ETI-161 digital panel meter

A most handy instrument. Hands up all those readers who have an Intersil DPM Evaluation Kit (ICL7106EV) lying around in the bottom of a drawer! Here's your last chance to turn it into something useful. Most of the components in the evaluation kit can be used in this project — chief among them being the ICL7106 IC, the liquid crystal display and the capacitors. Printed circuit boards can be obtained from the list of pc board suppliers at the end of this column.

For those shopping around for parts, many suppliers carry the ICL7106 — such as Rod Irving Electronics, Dick Smith Electronics and All Electronic Components. The latter are official Intersil distributors, incidentally. The LAD204 liquid crystal display may be harder to get. However, Dick Smith Electronics carry a 4½-digit liquid crystal display, catalogue No. Z-4175, which plugs straight into our board and works — only you get a 3½-digit readout.

A number of suppliers will be carrying this project as a kit and we advise you scan the advertisements.

## ETI-652 Atari joystick interface

Add a 'pilot's control' to your System 80! Well, not quite, but this simple add-on interface allows you to use an Atari or Commodore joystick for on-screen graphics control of your System 80. The Atari-type joystick is widely available as an accessory and all the parts for this project are more or less bog standard. Dick Smith Electronics list the joystick, catalogue No. X-2020, at \$19.90. However, D.S.E. indicate they will be stocking a kit for this project.

This interface allows you to use the joystick on some of the Big Five and

Adventure International games software that calls for a joystick.

## PC Boards, panels etc.

Almost every pc board ever published by ETI may be obtained from the following firms:

RCS Radio  
651 Forest Rd  
Bexley NSW 2207

All Electronic Components  
118 Lonsdale St  
Melbourne Vic. 3000

In addition, many of our boards are stocked by Radio Despatch Service or, if they haven't got your requirements in stock, can have them made to order for you. Here they are:

Radio Despatch Service  
869 George St  
Sydney NSW 2000

The same three firms can provide front panels for our projects, too.

For the projects we've done over the past three to five years, many (if not most) pc boards and panels may be obtained through the following firms:

Mini Tech  
P.O. Box 9194  
Auckland N.Z.

James Phototronics  
522 Grange Rd  
Fulham Gardens S.A. 5024

Sunbury Printed Circuits  
Lot 14, Factory 3, McDougall Rd  
Sunbury Vic. 3429

Jemal Products  
P.O. Box 168  
Victoria Park W.A. 6100

Rod Irving Electronics  
425 High St  
Northcote Vic. 3070

Electronic Agencies  
115-117 Parramatta Rd  
Concord NSW 2137

and  
119 York St  
Sydney 2000.



64K S550 STATIC NOW AVAILABLE \$399 + TAX  
64K S100 STATIC NOW AVAILABLE \$399 + TAX

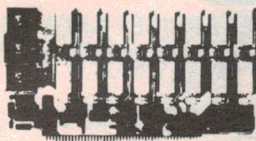
DON'T FORGET TO CHECK WITH US BEFORE YOU BUY A COMPUTER OR OTHER PRODUCTS

# ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA

64K SINGLE BOARD COMPUTER KIT NOW ONLY \$499 + TAX.

## 16K EPROM CARD-S 100 BUSS



\$89.50

KIT

BLANK PC BOARD

\$49

USES 2708's

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE \$5.90EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD \$36

## 16K STATIC RAM KIT-S 100 BUSS

KIT \$179  
A&T \$199



### KIT FEATURES

1. Addressable as four separate 4K blocks
2. ON BOARD BANK SELECT circuitry (Cromeco Standard) Allows up to 512K on line
3. Uses 2114 (450NS) 4K Static Rams
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PM 67
9. LOW POWER under 1.5 amps TYPICAL from the +5 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K

BLANK PC BOARD W DATA \$55

LOW PROFILE SOCKET SET \$22

SUPPORT IC'S & CAPS \$29

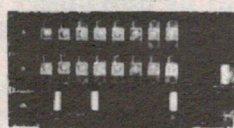
ASSEMBLED & TESTED ADD \$30

OUR #1 SELLING RAM BOARD!

## S100 COMPUTER PRODUCTS

### 32K S-100 EPROM CARD

NEW!



\$99.95

KIT

USES 2716's

Blank PC Board - \$59

ASSEMBLED & TESTED

ADD \$30

SPECIAL: 2716 EPROM's (450 NS) Are \$5.90 EA. With Above Kit.

### KIT FEATURES:

1. Uses +5V only 2716 (2Kx8) EPROM's
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible
4. Addressable as two independent 16K blocks
5. Cromemco extended or Northstar bank select
6. On board wait state circuitry if needed.
7. Any of all EPROM locations can be disabled
8. Double sided PC board, solder-masked, silk-screened
9. Gold plated contact fingers
10. Unselected EPROM's automatically powered down for low power
11. Fully buffered and bypassed
12. Easy and quick to assemble.

## 16K STATIC RAM SS-50 BUSS

PRICE CUT!

\$199 KIT  
A&T \$219

FULLY STATIC AT DYNAMIC PRICES



32K STATIC ALSO AVAILABLE

### KIT FEATURES

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout Gold fingers
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

BLANK PC BOARD - \$49 COMPLETE SOCKET SET - \$22 SUPPORT IC'S AND CAPS - \$45

\* \* \* AVAILABLE AGAIN \* \* \*



- 16K Dynamic Ram Board
- Fully Expandable to 64K
- Assembled, tested and guaranteed
- S100 Compatible

16K Dynamic RAM Board assembled and tested: Special \$269 plus tax (4m Hz) \$299 plus tax (4mHz) This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested \$289 plus tax (4mHz)

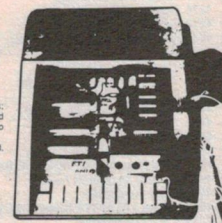
48K Assembled and tested \$309 plus tax (4mHz)

64K Assembled and tested \$329 plus tax (4mHz)

## ETI 660 THE \$99 COMPUTER!

### FEATURES INCLUDE:

Colour capability, operates from optional 9V plugpack; 1K memory expandable to 3K on-board; single-board construction, cassette interface, audio output, simple to program (uses Chip-8) Expansion projects coming up include ASCII keyboard, light pen, games software, etc. Starter Kit (1K RAM, B&W Video) \$99.00 9V, 1 amp plug pack to suit \$12.50 Colour video option \$13.50 RAM Expansion (add to PCB) \$16.00



## ETI636 7 SLOT MOTHERBOARD WITH ACTIVE TERMINATION

Kit of Parts \$89.00. Assembled and tested \$115.00, inc tax. RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg. 10A, ± 16V Unreg. Kit of parts \$89.90 inc tax A&T \$109.00 inc tax Write for list of other power supplies. Tax free prices also available.

## SINGLE BOARD COMPUTER KIT NOW ONLY \$499 Including tax (\$435 tax exempt)

Also available: Blank PCB's with Roms \$275 + Tax. Assembled & Tested \$559 + Tax.

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure, and you have a total Business System for about 1/3 the cost you might expect to pay.

FEATURES: (Remember, all this on one board!)

### 64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

### Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software

### SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: \$65

### BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

### REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: \$19

### PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

### 24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

### FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M 2.2.

### FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: \$29

SIZE: 8 1/2 x 13 1/4 IN.  
SAME AS AN 8 IN. DRIVE.  
REQUIRES: +5V @ 3 AMPS  
+ 12V @ .5 AMPS.

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General enquiries (03) 489-8131. Mail order enquiries (03) 481-1436. Ritronics Wholesale (03) 489-7099. (Tax Exempt Enquiries)

Prices subject to change without notice. Send 60¢ and SAE for free Price lists. MAIL ORDERS PO BOX 235, NORTHCOTE, Vic. 3070. Minimum pack and post \$5.00. Telex AA38897. PLEASE WRITE OR RING FOR THE BEST POSSIBLE PRICES ON DISC DRIVES, PRINTERS AND OTHER COMPUTER COMPONENTS.

ETI 8/82/4

MASSIVE PRICE CUTS ON BIG BOARD COMPUTER



# JAYCAR - for hard to get Semiconductors

WE NOW STOCK HUNDREDS MORE IC's THAN MOST OF OUR COMPETITORS AT THE BEST PRICES AROUND



## CMOS

4000	Dual 3 Input NOR Gate	40
4001	Quad 2 Input NOR Gate	35
4002	Dual 4 Input NOR Gate	38
4006	16 Stage Static Shift Register	40
4007	Dual Complementary Pair Plus Inverter	38
4008	4-Bit Full Adder	95
4009	Hex Buffer (Inverting)	\$1.10
4010	Hex Buffer (Non-Inverting)	90
4011	Quad 2 Input NAND Gate	35
4012	Dual 4 Input NAND Gate	20
4013	Dual D Flip Flop	90
4014	8-Stage Static Shift Register	\$1.00
4015	Dual 4-Bit Static Register	95
4016	Quad Analog Switch	50
4017	Decade Counter/Divider	\$1.20
4018	Resettable Divide-by-N	50
4019	Quad AND OR Select Gate	75
4020	14-Stage Binary Counter/Divider	\$1.45
4022	Divide-by-8 Counter/Divider	\$1.25
4023	Triple 3-Input NAND Gate	28
4024	7-Stage Binary Counter/Divider	\$1.18
4025	Triple 3-Input NOR Gate	35
4026	Decade Counter-7 Seg Output	\$2.20
4027	Dual JK Flip Flop	90
4028	BCD-to-Decimal Decoder	\$1.18
4029	Presetable Up-Down Counter	\$1.25
4030	Quad 2 Input EXCLUSIVE OR Gate	80
4031	64 Stage Static Shift Register	\$2.20
4032	Triple Serial Adder	\$1.95
4034	8 Stage TRI STATE Universal BUS Register	\$2.95
4035	4 Bit Shift Register	\$1.95
4038	Triple Serial Adder (Negative Logic)	\$1.65
4040	12 Stage Binary Counter	70
4042	Quad Clocked D Latch	\$1.55
4046	Micropower Phase-Lock Loop	\$1.75
4047	Low Power Mono/Astable Multi	75
4048	Hex Inverting Buffer	60
4049	Hex Buffer (Non-Inverting)	95
4051	8 Channel Analog Multiplexer	\$1.75
4053	Triple 2 Channel Analog Multiplexer	50
4055	Quad Analog Switch	80
4067	1-of-16 Analog Switch	\$2.95
4068	8 Input NAND Gate	48
4069	Hex Inverter	70
4070	Quad 2 Input EXCLUSIVE OR Gate	48
4071	Quad 2 Input OR Gate	65
4073	Triple 3 Input AND Gate	60
4075	Triple 3 Input OR Gate	\$1.25
4076	Quad D Flip Flop	50
4077	Quad EXCLUSIVE NOR Gate	65
4078	8 Input NOR Gate	60
4081	2 Input AND Gate	60
4083	Quad 2 Input NAND Schmitt Trigger	\$1.75
4411	Decade Counter 7 Seg Output	\$2.20
4500	501 Triple Gate	\$2.50
4502	Strobed Hex Inverter	\$1.95
4503	Hex 3 Stage Buffer (Non Inverting)	95
4508	Dual 4-Bit Latch	\$5.00
4511	BCD to 7 Seg Decoder/Driver	\$1.25
4512	8 Channel Data Selector	\$2.95
4514	4 to 16 Line Decoder/4 Bit Latched	\$1.50
4517	Dual 64 Bit Static Shift Register	\$1.50
4518	BCD Up Counter	\$1.50
4520	Dual Binary Up Counter	\$1.50
4526	Programmable 4-Bit Binary Counter	\$2.65
4528	Dual Mono Multi	\$1.50
4538	Dual Mono/Precision Multi	\$2.65
4543	BCD to 7 Seg Latch/Decoder/Driver/LCD	\$1.95
4553	3 Digit BCD Counter	\$6.50
4557	1 to 64 Bit Variable-Length Shift Register	\$3.50
4581	4 Bit	\$3.50
4582	Look Ahead Carry Block	\$2.50
4584	Hex Schmitt Trigger	\$1.65

## 74LS TTL

74LS00	Quad 2 Input NAND Gate	35
74LS01	Quad 2 Input NOR Gate	40
74LS02	Quad 2 Input NOR Gate (oc)	40
74LS03	Quad 2 Input NAND Gate (oc)	40
74LS04	Hex Inverter	40
74LS05	Hex Inverter (oc)	40
74LS08	Quad 2 Input AND Gate	40
74LS09	Quad 2 Input AND Gate (oc)	40
74LS10	Triple 3 Input NAND Gate	40
74LS11	Triple 3 Input AND Gate	40
74LS12	Triple 3 Input NAND Gate (oc)	40
74LS13	Dual NAND Schmitt Trigger	85
74LS14	Hex Schmitt Trigger	85
74LS20	Dual 4 Input NAND Gate	40
74LS21	Dual 4 Input AND Gate	35
74LS27	Triple 3 Input NOR Gate	60
74LS30	8 Input NAND Gate	50
74LS32	Quad 2 Input OR Gate	45
74LS33	Quad 2 Input NOR Gate (oc)	50
74LS42	1 of 10 Decoder	95
74LS47	BCD to 7 Seg Decoder/Driver (oc)	\$1.45
74LS48	BCD to 7 Seg Decoder/Driver	\$2.95
74LS49	BCD to 7 Seg Decoder/Driver	\$1.95

74LS73	Dual JK Flip Flop with Clear	95
74LS74	Dual D Flip Flop with Preset & Clear	75
74LS75	4 Bit Bistable Latch	60
74LS76	Dual JK Flip Flop	60
74LS78	Dual JK Flip Flop	60
74LS83	4 Bit Full Adder	\$1.00
74LS85	4 Bit Magnitude Comparator	\$1.25
74LS86	Quad 2 Input EXCLUSIVE OR Gate	50
74LS90	Decade Counter	75
74LS92	Divide by 12 Counter	\$1.25
74LS93	4 Bit Binary Counter	85
74LS95	4 Bit Shift Register	20
74LS107	Dual JK Flip Flop	75
74LS109	Dual JK Edge-Triggered Flip Flop	60
74LS112	Dual JK Edge-Triggered Flip Flop	75
74LS122	Retrig Monostable with Clear	\$1.10
74LS123	Dual Retrig Mono with Clear	55
74LS125	Quad BUS Buffer Tri-State (no enable)	75
74LS126	Quad BUS Buffer Tri-State (hi enable)	\$1.45
74LS138	1-of-8 Bit Decoder/Multiplexer	92
74LS139	Dual 2 to 4 Line Decoder/Multiplexer	\$2.95
74LS147	10 Line dec to 4 Line Priority Encoder	\$3.95
74LS148	8 Line to 3 Line Priority Encoder	75
74LS151	1 of 8 Selector/Multiplexer	\$1.00
74LS153	Dual 4 Line to 1 Line Selector/Multiplexer	\$1.00
74LS155	Dual 1 of 4 Decoder	\$1.50
74LS156	Dual 1 of 4 Decoder (oc)	\$1.50
74LS157	Quad 2 Input Multiplexer (Non-Inverting)	\$1.00
74LS158	Quad 2 Input Multiplexer (Inverting)	75
74LS160	BCD Decade Counter Asynch. Reset	95
74LS161	4-Bit Binary Counter Asynch. Reset	95
74LS162	BCD Decade Counter Synchron. Reset	\$1.00
74LS163	4-Bit Binary Counter Synchron. Reset	\$1.20
74LS164	8-Bit Shift Register	60
74LS165	8-Bit PSIO Shift Register	\$2.95
74LS175	Quad D Type Flip Flop	\$1.25
74LS190	Up/Down Decade Counter	\$1.15
74LS191	Up/Down Binary Counter	95
74LS192	Up/Down Decade Counter Dual Clock	\$1.65
74LS193	Up/Down Binary Counter Dual Clock	\$5.00
74LS195	4-Bit Left-Right Shift Register	\$2.25
74LS221	Dual Monostable Multivibrator	\$3.50
74LS240	Octal Tri-State Driver	\$3.50
74LS241	Octal Tri-State Driver	\$3.55
74LS244	Octal Buffer/Driver	\$2.95
74LS245	Octal Bus Transceiver	85
74LS257	Quad 2 Input Multiplexer Tri-State	\$2.50
74LS258	Quad 2 Input Multiplexer Tri-State	\$1.25
74LS259	4 Bit Addressable Latch	\$2.95
74LS266	Quad EXCLUSIVE NOR Gate (oc)	60
74LS273	Octal D Type Flip Flop	\$1.25
74LS365	Hex Buffer with Common Enable	70
74LS366	Hex Inverter with Common Enable	\$2.95
74LS367	Hex Buffer 4 Bit and 2 Bit	\$2.50
74LS368	Hex Inverter 4 Bit and 2 Bit	\$3.50
74LS373	Octal Transparent Latch	95
74LS374	Octal D Type Flip Flop	95
74LS393	Dual LS93	

## MEMORIES

2102	1K x 1 RAM	\$1.95
2114	1K x 4 RAM 350ns	\$2.45
2114	1K x 4 RAM 450ns	\$1.45
4116	16K x 1 Dynamic RAM 250ns	\$2.50
2708	1K x 8 EPROM	\$12.50
2716	2K x 8 EPROM (Single +5V)	\$7.95
2532	4K x 8 EPROM (Single +5V)	\$6.50
2564	8K x 8 EPROM (Single +5V)	\$35.00

## Z-80A/6800

Z-80A	CPU 4MHz	\$8.50
Z-80A	P10 4MHz	\$8.50
Z-80A	CTC 4MHz	\$8.50
Z-80A	SIO/0 4MHz	\$20.95
Z-80A	SIO/1 4MHz	\$20.95
Z-80A	SIO/2 4MHz	\$20.95
Z-80A	DART 4MHz	\$32.95
Z-80A	DMA 4MHz	\$20.95
6802	CPU	\$11.00
6821	PIA	\$4.95

## SUPPORT

8255	PPI	\$9.95
5303	UART	\$12.95
1771	Floppy Disk Controller	\$19.95
1488	RS232 Quad Line Driver	\$1.50
1489	RS232 Quad Receiver	\$1.50
8131	6-Bit Comparator (Negative Out)	\$4.95
81LS97	Octal Buffer	\$2.35
81LS98	Octal Buffer (Inverting)	\$2.35

## SPEECH SYNTHESISER

DT1050	National Digitaltalker Processor & ROM Set	\$95.00
DT1067	National Digitaltalker Second ROM Set	\$89.00

Send SAE for more details. NOTE new low price. Data sheets included in chip sets.

## LINEAR DEVICES

ZN414	\$2.50	LM381N	\$3.95
TL061	\$2.45	LM381AN	\$5.95
TL062	\$2.45	LM382	\$2.60
TL064	\$4.75	LM394CH	\$5.95
TL071	89	NE555	35
TL072	\$1.45	LM7555	\$1.95
TL074	\$3.50	LM556	\$1.10
TL075	\$3.50	LM567	\$1.95
TL081	65	NE570	\$7.50
TL082	95	NE517	\$6.50
TL084	\$2.95	LM723	\$1.45
TL085	\$3.50	LM741	\$1.95
LM234	\$3.50	LM747	\$1.95
LM301	60	LM1496	\$1.45
LM307	90	LM3046	\$1.45
LM308	\$1.25	LM3080	\$1.30
LM311	95	LM3130	\$1.80
LM319	\$3.50	LM3140	\$1.45
LM324	\$1.20	LM3900	\$5.95
LM334	\$2.50	LM3914	\$6.50
LM339	95	LM3195	\$4.50
LF347N	\$3.50	LM39152	\$12.50
LM348	\$2.25	LM4136	\$1.85
OM350	\$9.50	LM4558	\$1.55
LM361	\$3.75	LM5534N	\$1.80
LM380	\$1.48	LM5534N	\$2.00

## SPECIAL FUNCTION

SA80600	Door Chime	\$9.95
AY-1-5050		\$9.50
TEA-10P2	PAL Colour Encoder	\$17.50
TDA-1022	Bucket Brigade	\$29.50
EXAR 2208	Function Generator	\$5.95
MOC-3020	TRIAC Opto Coupler	\$2.50
MM 5837	Noise Generator	\$3.90
TA 7205P	Audio Amp	\$4.50
7216 IJI	Audio Amp	\$47.50
SN 76480NF	Sound Effects Generator	\$5.95
AY-1-0212	Top Octave Synthesiser	\$19.50

## VOLTAGE REGULATORS

7805	5V+ Regulator TO-220/amp	\$1.05
7905	5V- Regulator TO-220/amp	\$1.65
7812	12V+ Regulator TO-220/amp	\$1.05
7912	12V- Regulator TO-220/amp	\$1.65
7815	15V+ Regulator TO-220/amp	\$1.05
7915	15V- Regulator TO-220/amp	\$1.65
7818	18V+ Regulator TO-220/amp	\$1.00
7918	18V- Regulator TO-220/amp	\$1.00
LM323	3amp 5V TO-3	\$1.50
LM309	1.5amp 5V TO-3	\$7.50
LM317T	2-30V adjustable 1amp TO-220	\$2.80
LM317KC	2-30V adjustable 3amp TO-3	\$6.50
LM318H		\$3.50
LM337K		\$9.50
LM396K		\$19.50

## LED's

5mm Red	15
5mm Green	26
5mm Yellow	30
5mm Orange	28
3mm Red	18
3mm Green	28
3mm Yellow	40
Rectangular Red	40
Rectangular Green	40
Rectangular Yellow	40
Flashing Red	45
Flashing Red 10+ each	49

New JAYCAR store opening next month at Carlingford - right at Carlingford Court, next door to Kentucky Fried Chicken

**Jaycar**



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Mon- Fri 8.30 to 5.30pm  
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# "Why buy just a video game when you can get a full colour computer for this price."

A computer like this would have been science fiction a few years ago. Now it's a reality. It's the Commodore VIC-20, a full-fledged, expandable colour computer that costs little more than video games.

Everybody loves video games and the VIC-20 has some of the best. But the Commodore VIC-20 can also help the kids with their homework and mum with her budgeting. Dad can even take the light, portable VIC-20 to the office for financial and business applications.

And Commodore has many more applications on the way.

## With Full Capability For:

- Education programs
- Recreational programs
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- Includes Microsoft, PET BASIC
- Full-size typewriter-style keyboard
- Easy to follow instruction manual
- Memory expansion to 32K RAM
- Connects to any TV set
- 66 graphic characters
- 25K total memory
- 4 sound generators
- 16 colours



## The computer for everyone.

The VIC-20 is the friendliest way we know to learn computing. It has a full computer keyboard even a small child can operate.

It plays music, has exciting graphics and lets you create pictures. It even tells you when you've made a mistake and how to correct it. The VIC-20 can take your children from pre-school through post-graduate studies.

Why get just another game that could end up in the closet? Get an honest-to-goodness computer for just \$399. Get the Commodore VIC-20.

Learn more about Commodore, the micro-computer you can depend on. Call or write for the name and location of your Commodore dealer nearest you.

**The Commodore Information Centre,  
3 Campbell St., Artarmon NSW 2064. Phone: 437 6296.**



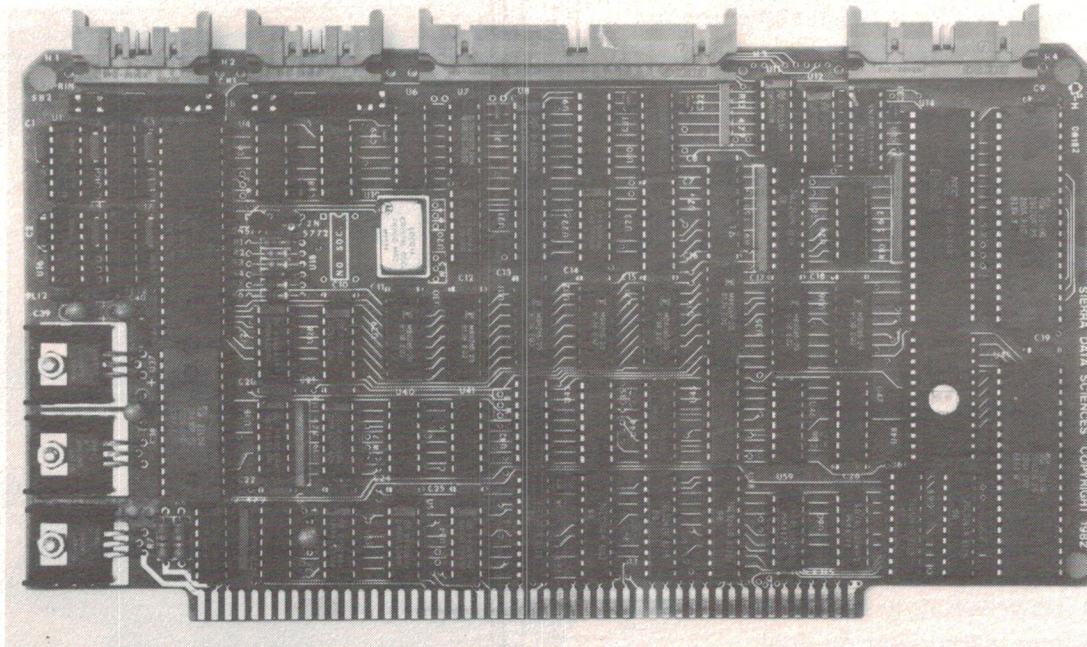
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COMPUTER



Introducing the first complete single board computer for the S100 bus . . .

# SBC100 MASTER PROCESSOR

Provides all resources necessary for stand-alone CP/M operation, yet allows expansion into multi-processor and hard disk systems.



## Features:

- Z-80A 4MHz
- Two serial ports (Z-80 DART — SIO optional)
- Two parallel ports (Z-80A PIO)
- NEC 765 floppy disc controller supports 4, 203 mm drives double sided, double density.
- 64K RAM (no wait states)
- 2732 4K EPROM supplied with system executive, may be switched out under software control.
- Intelligent Winchester interface (optional).
- IEEE 696 S100 standard interface.
- Software programmable baud rates.
- Time-of-day clock.
- Will operate stand-alone.
- Expandable into multi-user and hard disk systems.
- 4-layer PCB, all IC's socketted, high quality construction.

The Sierra Data Sciences SBC100 Master Processor is the first S100 single board computer that provides all resources necessary to run CP/M.

Standard features provided are an RS232 terminal port; a serial printer port; two parallel ports that may be used as a Centronics or intelligent Winchester interface; a floppy disc controller; 64K of memory; and a Z-80A running at 4MHz. A sophisticated CP/M implementation designed to make use of all the features of this board is also available.

While perfect for single user environments, this board was designed to be equally suitable for both time-sliced and multi-processor networking systems. A satellite processor card, the SBC100S, has been designed to assist in multi-processor implementations. As data transfers are via I/O ports on the S100 bus, it can be used with other host processors, even 16-bit machines. A full implementation of the powerful TURBODOS multi-user operating system is available.

We can provide individual boards, metalwork, single user systems, or complete multi-processor machines. For the state-of-the-art in microcomputing contact us now.



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# COMPUTING TODAY

## Dick Smith releases approved direct-connect modem

Direct interconnection between computers via the telephone lines is common practice overseas — particularly in the US. This practice has been somewhat held back here by the Telecom-imposed necessity of either using an acoustic coupler or leasing appropriate 'approved' equipment.

The Dick Smith organisation has just announced the release of a Telecom-approved direct-connect low-cost modem, called the 'Dataphone', that they claim will turn this whole scene around. Dick Smith explains (from his press release):

"Until now, people have had only two choices. One was to lease a modem from Telecom, but this costs about \$800 a year. This is more than the price of many personal computers! The other option was to buy an acoustic-coupling modem — but these still cost around \$400 — far too expensive. It was obvious that

the communications revolution wasn't ever going to get under way in Australia until people could buy a really low-cost modem. So we decided to make it happen!"

When DSE began work on the Dataphone, Telecom Australia were not yet prepared to accept privately-owned direct-connect modems of the discrete type for authorisation as a 'Permitted Attachment'. So DSE began negotiating with Telecom in parallel with the technical development, to see if official policy could be updated. This two-pronged

approach paid off, because the Dataphone became the first — and currently the only — direct-connect discrete modem to be given Telecom authorisation (Permit No. C82/37/557).

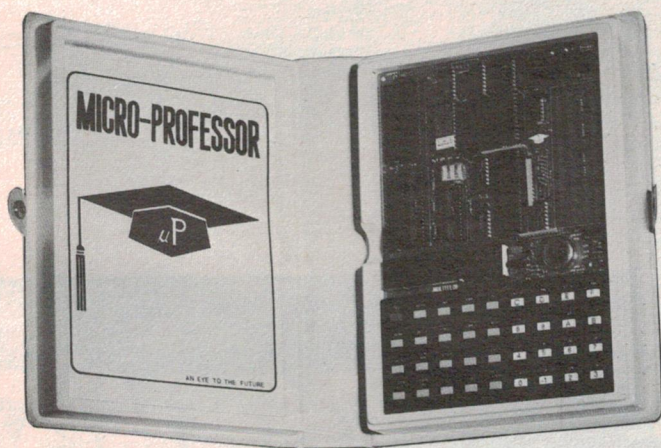
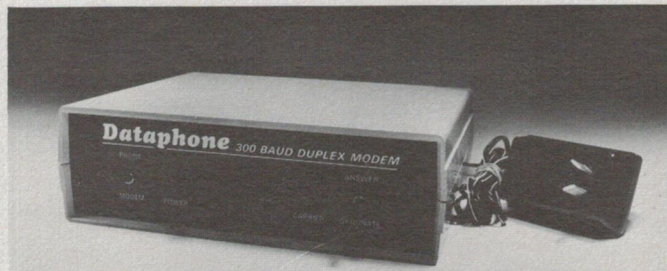
Direct-connect modems are preferred because of the greater reliability compared to acoustic-coupled types.

The Dataphone is Australian-designed and manufactured. The unit just plugs in and has a standard RS-232C interface, permitting it to be used with any computer or data

terminal with that interface. It is claimed to comply with Telecom regulations and CCITT recommendation V.21, and is thus compatible with other standard modems.

It operates in either answer or originate mode at 300 baud. A switch permits selection of the mode. A carrier detect signal output and indicator is included for circuit monitoring.

The Dataphone will cost \$169 retail and was scheduled to be available in mid-July.



### Learn about micros with the Microprofessor

Emona Enterprises have just released a low cost microprocessor learning aid called the 'Microprofessor'.

The MPF-1 Microprofessor features a Z80 microprocessor — the most widely used 8-bit processor, and the basic unit comes as a single board computer complete with 36-key keyboard, a 6-digit display,

2K of RAM, 2K monitor ROM, cassette interface (for storing programs on an ordinary audio cassette tape), 24 input/output lines for expansion (expansion units are available) and a

speaker for sound output. It's all powered by a plug pack.

Special manuals are provided aimed at helping you teach yourself by experiment using the Microprofessor.

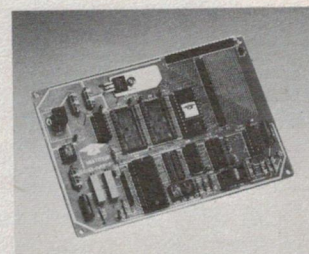
Amazingly, it sports a tiny BASIC interpreter in a PROM you can plug in. Commands include continue, call, for ... next, goto, gosub, input, if ... then, let, list, load, new, print, return, run, save, stop. You get a form of mnemonic readout on the display.

Cost of the basic MPF-1 is \$115 plus sales tax!

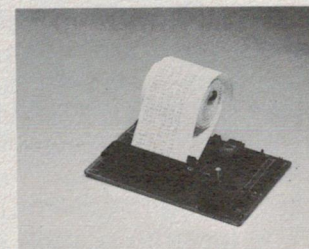
Optional expansion units include a speech synthesiser (!), an EPROM programmer and we hear a printer is in the wind.

Accessories available for the MPF-1 board include: a Z80 counter-timer chip, a Z80 parallel I/O chip, a breadboard for playing with circuits, extra 2K RAM plus 2K and 4K blank EPROMs.

Full details of this interesting new development are obtainable from



Speech synthesiser

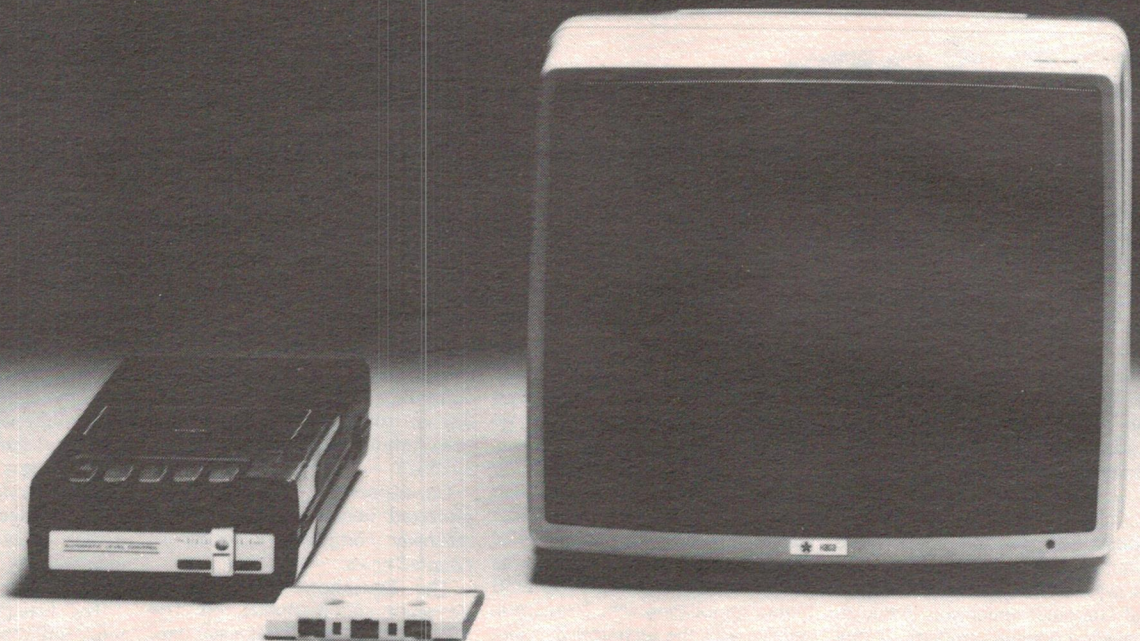


Printer

Emona Enterprises, CBC Bank Building, 661 George St, Sydney 2000, (02)212-4815 or Radio Parts, 562 Spencer St, West Melbourne 3003, (03)329-7888.



# *microbee, more than you ever*



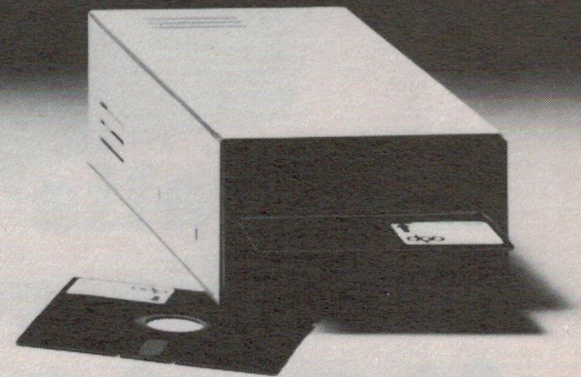
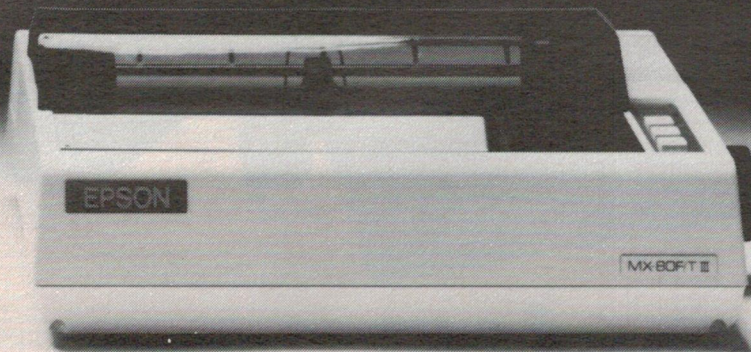
With one giant step, Australia's MicroBee brings the power of the personal computer within your reach. MicroBee is now ready built with a superb new case. Yet incredibly it costs no more. The no compromise computer you can afford. MicroBee is a complete learning package. Explore and master programming with the BASIC manuals, and inbuilt 16K ROM BASIC. Find out why the NSW Department of Education chose MicroBee.

MicroBee is powerful and "friendly". You learn to control the built in sound, graphics and write and correct programs more easily with MicroBee. Printers, modems and cassette storage plug straight in. The optional parallel and Z80





# *expansion power thought possible*



port let you connect joysticks or use the world standard S100 bus. MicroBee grows with you. Inexpensively. Add disc drives, colour graphics and EPROM programmers. Write programs in Z80 code. Or upgrade to disc drives and CP/M with the new 64K memory card. MicroBee, your first class ticket into computing.

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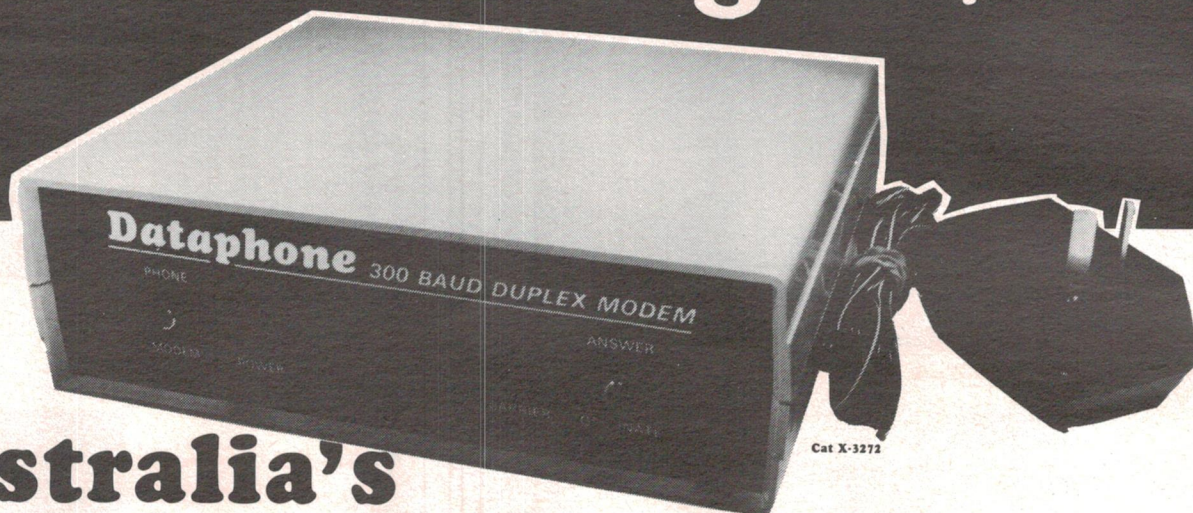
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**Don't pay \$400!  
Unbelievable price  
breakthrough: \$169**



## **Australia's first direct modem to meet new Telecom regulations!**

The data communications revolution has now reached Australia. More and more personal computer users are communicating with other computers via the telephone network, to exchange data and programs with other personal computer users and to access the growing amount of valuable information in the big computer "data bases".

Until now, the only type of telephone modem available for use with personal computers has been the acoustic coupled type. These are expensive, and also depend heavily on the telephone's old-fashioned carbon microphone. As a result even the best units of this type are often not capable of really reliable, trouble-free operation. But now, after months of development work and negotiation with Telecom Australia, Dick Smith Electronics presents the Dataphone – a telephone modem that really is suitable for personal computers. It's not an acoustic-coupled type, but a true high performance direct connect modem. And it's authorised by Telecom. Even more importantly, it will cost you less than half the price of a comparable acoustic modem!

Here are just some of Dataphone's many exciting features:

- ★ Simple plug-in connections.
- ★ Full duplex operation for speed and convenience.
- ★ Operates at the standard data rate of 300 baud.
- ★ Designed and manufactured in Australia.
- ★ Standard RS 232C interface – so it can be used with almost any personal computer.
- ★ Fully complies with both Telecom regulations and CCITT Recommendation V.21 – hence it is not only legal, but also fully compatible with other modems. (Telecom Authorisation No. C82/37/557).
- ★ Operates in either Answer or Originate mode, at the flick of a switch, for complete flexibility.
- ★ Has a phone/modem switch, for convenient operation.
- ★ Comes complete with approved power supply and detailed, easy to understand user manual.

And the best news of all -  
it costs only

**\$169**

**DICK SMITH  
Electronics**



**See Page 144 for  
address details**



# Printout



## Set your Apple singing

**Well, playing tunes anyway. The ARP Chroma is a synthesiser instrument that links to an Apple II to provide programmability and flexibility.**

The Apple II becomes part and parcel of the synthesiser. With the Chroma and the Apple, you can create a 32-channel programmable synthesiser with eight independent voices, plus you get mass storage (with composition menus!) and you can store all sorts of colourations

and spectra you require.

If, as a computer hack, you're a frustrated composer, have a look at the ARP Chroma. See Hutchings Pianos and Electronic Keyboard Specialists, 5-7 Edgecliff Rd, Bondi Junction NSW 2022. (02)387-1376.

## Computer Country and the Australian Beginning

**We've mentioned the Australian Beginning several times in previous issues of ETI, each time adding new details available through the system, giving information on special offers, how to join, and so on. We thought it was time we summarised for ETI readers just what the Australian Beginning is all about.**

Basically, through the Australian Beginning system microcomputer and word processor system owners, as well as owners of 'dumb' terminals, are able to access:

- a wide variety of information sources and data banks, including news, weather, airline schedules, investment advisory services, sports, government information, etc.
- full electronic mail facilities
- many computer programs, including entertainment, educational

aids, programming and diagnostic tools, a wide range of financial and business applications

- the system computer's huge storage capacity to use the large on-line applications programs, and to put their own programs on the Australian Beginning's system for disaster back-up
- a 'shopping by computer' system to help get the best price on many consumer and business items
- the telex system — Australian Beginning users can send telex

## New format in computing exhibitions

**The ninth Australian Computer Conference and Exhibition, being held in Hobart during August 23-27 1982, marks the end of the Australian Computer Society's biennial conferences. A new series of conference/exhibitions have been planned to keep up with the latest technology, beginning in 1983 on an annual basis.**

Riddell Exhibition Promotions Pty Ltd, in conjunction with the Australian Computer Society, have reached an agreement which will see the National Convention staged annually, primarily between Melbourne and Sydney. This will begin with the tenth Australian Computer Conference and Exhibition (10ACCE) to be held at the Royal Exhibition Building, Melbourne, September '83, followed by Sydney, November '84. Suppliers of the industry will not have to wade through the usual numerous exhibitions, but

support only one major calendar event a year.

The Exhibition will cater for all areas of the computer industry from the largest mainframes to the smallest personal computers, and a full array of peripherals, media supplies and office automation, furniture, transport and software. For further information please contact Peter Petherick, Riddell Exhibition Promotions Pty Ltd, 166 Albert Road, South Melbourne Vic. 3205. (03) 699-1066.

## Applecase

**Computer Force have available a robust carrying case for Apple owners who need portability.**

Constructed of aluminium and stainless steel externally, the case is claimed to withstand a considerable amount of abuse. Internally, the case has been moulded to suit an Apple II and its accessories. You can fit the Apple, two disk drives, one box of diskettes, game paddles and a number of cables and manuals. Dimensions are 700 mm long, 500 mm wide and 220 mm deep. Price is \$275.



Enquiries to Computer Force, P.O. Box 409, Artarmon NSW 2064. (02)95-5624.

messages through the system to any telex user, and receive telex messages.

As mentioned in the July issue of ETI (p. 71), the Australian Beginning and Sigma Data are offering a low-cost package including desktop terminal, acoustic coupler, Australian Beginning lifetime membership and a prepaid block of 60 hours' computer use. The system is run on Data General computers, and is available for \$20 a week over five years.

Another new facility is a computer insurance package against computer breakdown or accidental damage. The premium of \$135 annually also covers software, and includes the full cost of repair, or in the event of total loss complete replacement of the system. Inform-

ation on the policy is available through David Hornidge Insurances Pty Ltd, 422 Collins St, Melbourne Vic. 3000. (03)67-8583.

Computer Choice, a franchisee of Computer Company, is now opening in Perth, and carries a wide range of microcomputer systems, including the Apple, Hitachi Peach, Northstar, NEC, Osborne, Atari, and others. Computer Choice will also be the prime WA dealer for the Australian Beginning system, as well as dealing with service and informational seminars on the Australian Beginning.

For further information on the Australian Beginning contact Gary Alpert, Computer Country Pty Ltd, 338 Queen St, Melbourne Vic. 3000. (03)329-7533.



# SUPERCOMPUTER GOES MULTI USER

**THE WORLDS MOST  
POWERFUL CP/M  
COMPATIBLE  
COMPUTER.**

Dual 8 & 16 Bit 6MHz cpu to run CP/M & CP/M-86 or I/OS or MULTI/OS with SUPERAED offering features and expandability not equalled on any other system.  
\*Available in two desk styles and desktop or 19" rack mount versions\*

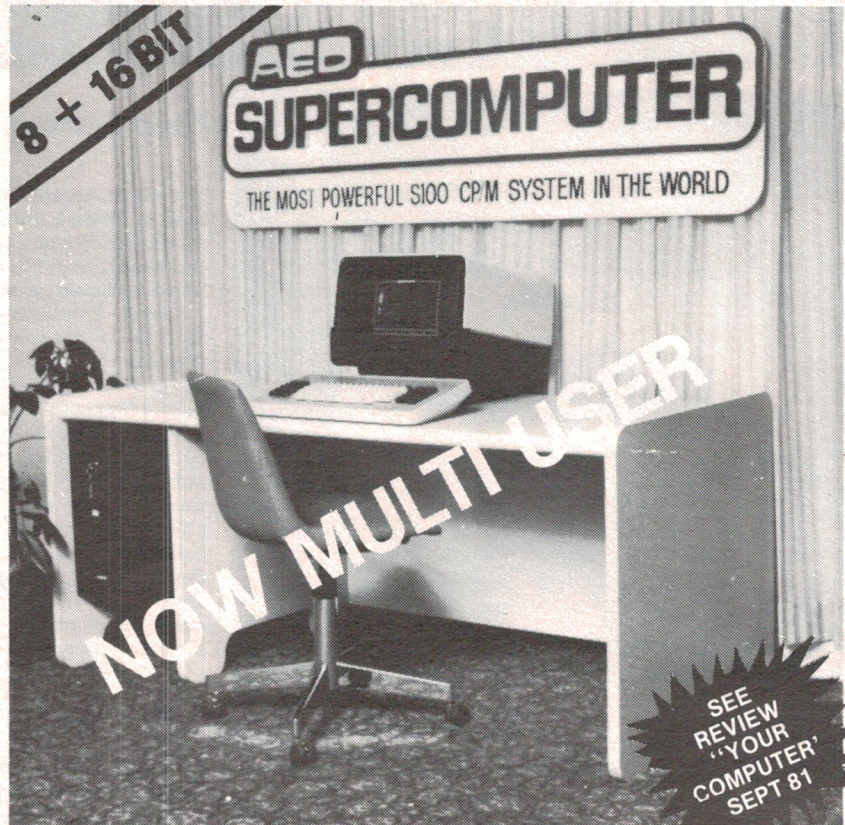


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PRODUCTS**

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TELEX AA70664



AT LAST AED HAS ENTERED THE MULTI USER ARENA. BY IMPLEMENTING MULTI USER FACILITIES ON THE "SUPERCOMPUTER".

WE HAVE AVOIDED IMPLEMENTING MULTI USER FOR THE LAST 2 YEARS BECAUSE WE BELIEVED INSUFFICIENT MULTI USER TECHNOLOGY HAD DEVELOPED FROM THE SYSTEM SOFTWARE HOUSES. THOSE MULTI USER OPERATING SYSTEMS THAT WERE WELL ENGINEERED EG. TURBODOS & OASIS WERE NOT COMPATIBLE WITH THE POPULAR CP/M AND WERE THEREFORE NOT ABLE TO OFFER VERY MUCH IN THE WAY OF END USER APPLICATION SOFTWARE SUPPORT. THE MULTI USER OPERATING SYSTEMS WHICH HAD CP/M COMPATIBILITY WERE NOT WELL ENGINEERED AND DID NOT HAVE TOTAL CP/M COMPATIBILITY EG. MP/M.

DURING THE LAST 2 YEARS WE KEPT OUR EYES OPEN FOR AN OPERATING SYSTEM WHICH SATISFIED BOTH OF THESE REQUIREMENTS. IN AUGUST 1981 "INFOSOFT" AND THEIR MULTI/OS ATTRACTED OUR ATTENTION AND SUBSEQUENT INVESTIGATION REVEALED THAT "INFOSOFT" WAS IN FACT A SLEEPING GIANT THAT WAS RESPONSIBLE FOR THE CREATION OF SUCH FAMOUS OPERATING SYSTEMS AS CREMENCO CDOS, S.D. SYSTEMS SDOS AND COSMOS AND MOSTEKS NEW MULTI USER AND NETWORK OPERATING SYSTEMS.

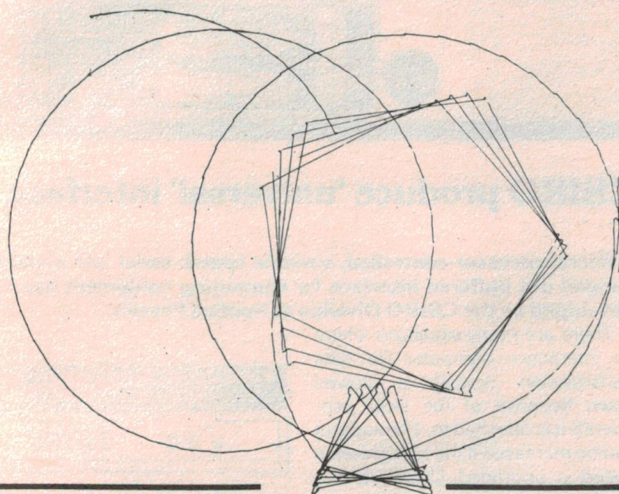
"INFOSOFT" HAVE RECENTLY STARTED MARKETING THEIR OWN SINGLE USER, MULTI USER AND NETWORK OPERATING SYSTEMS UNDER THEIR OWN BANNER, IN NOVEMBER 1981 WE SENT AN ENGINEER TO INFOSOFT OFFICES IN CONNETICUT TO EXAMINE THEIR MULTI USER OPERATING SYSTEM IN DETAIL, HE DETERMINED THAT MULTI/OS HAD MANY TECHNICAL ADVANTAGES OVER THE ALTERNATIVES AND THAT IT WAS ALSO TOTALLY CP/M AND CDOS COMPATIBLE. SOME OF THE OTHER ADVANTAGES ARE THAT IT LEAVES A LARGE TRANSIENT PROGRAMME AREA FOR EACH END USER, IT HAS KEYBOARD TYPE AHEAD, LARGE DISK HANDLING, SUBDIRECTORIES, DEFAULT DRIVES F R COM FILES AND BATCH FILES ETC ETC ...

WE DECIDED THAT AT LAST HERE WAS THE MULTI USER SYSTEM THAT AED AND ITS CLIENTS HAVE BEEN PATIENTLY LOOKING FOR. INFOSOFT WERE IMPRESSED BY THE SUCCESS OF OUR CP/M EXTENSION "SUPERAED" WHICH IS NOW BEING MARKETING BY SSM IN CALIFORNIA. INFOSOFT DECIDED TO INSTALL US AS THEIR SOLE REPRESENTATIVE IN AUSTRALIA, NEW ZEALAND AND NEW GUINEA.

AED IS NOW MAKING THESE OPERATING SYSTEMS AVAILABLE CONFIGURED ON THE SUPERCOMPUTER, ALSO THE CONFIGURATION PACKAGES ARE AVAILABLE TO OTHER OEM'S SO THAT THEY MAY IMPLEMENT THEM ON THEIR OWN MACHINES.

THE SUCCESS OF THE "SUPERCOMPUTER" HAS LEAD TO SALES AS FAR AWAY AS TONGA AND MEXICO. FOR COMPLETE INFORMATION ON THE SUPERCOMPUTER AND ITS OPERATING SYSTEMS WRITE TO US OR CALL US AND ARRANGE A DEMO.





## THE ARTICULATE TURTLE

The ETI office was recently honoured by a visit from a very articulate (as Turtles go...) Tasman Turtle. Yes folks, it was a walking, drawing, flashing, talking... *talking?*... Turtle.

The, er, machine was a Standard Turtle, fitted with the General Purpose Interface board and the Turtle Talk board. The latter is a digital speech synthesiser employing the National Semiconductor 'Digitalker' chip set with interfacing power supply circuitry and audio amplifier on board. Interrupt and mute circuitry is also included so you can 'pull' phonemes out of words in the vocabulary to make new words. A command facility also allows you to cut words short for building other words. These last three facilities permit very flexible word programming.

Alan Branch, who turned up at ETI with the articulate Turtle under his arm, brought a number of demonstration disks with him. In no time there was a crowd of staff gathered around the articulate Turtle watching/listening to it perform. Pity we never had time to fire it up on the ham bands for a 'digital' contact!

The Turtle Talk board is remarkably flexible, only requires simple (or no) interfacing and straightforward programming. The basic ROM set has a vocabulary of 143 words (and you can pull them apart to make your own), expandable on board to a 600 word vocabulary ROM set. You can get ROMs in other languages (French, German etc), and both European and American voices. The spoken words (and numbers) can be written on-screen, spelling determined by the programmer (i.e: colour, not color). Programming is done by simple POKE and PEEK instructions. Only a single line of programming is required for any word. Or you can program it with switches, even. Flexible Systems are currently selling the Turtle Talk board for \$254 plus tax. See their advert on page 43 of last month's issue.

Having played with speech, we went on to more mundane things — like programming the Turtle in Logo. It's simple. Type FORWARD and it goes forward, BACK and it goes back & etc. But it doesn't recognise JUMP! So we tried circles. You can get it to draw circles by dropping the pen and moving forward a few paces, turning a few degrees, moving forward a few paces, etc. Eventually, it draws a circle. Using a BIC finepoint we drew a circle in this manner about 300 mm or so in diameter — and closed the loop at the finish! Not 1 mm in or 1 mm out — it *closed*. It's hard to believe until you see it. Spirals, rotating geometric figures etc, are a piece of cake after that. Yes, it can draw pieces of cake too — depending on how good a programmer you are!

I was amazed at how having a Turtle and getting it to do things under program control hones one's programming skills. It certainly forces you to think clearly.

The amazing Articulate Turtle — now all we need is one with a male voice and one with a female voice, a few attachments and... anything could happen!

## Ram this on your ZX81

**The Melbourne firm of Vendale has released a 32K dynamic RAM add-on for the ZX81, priced at \$165.**

It simply plugs into the ZX81 expansion port and offers the full 32K. No extra power pack is required.

Details from Vendale Pty Ltd, Dept. T7, P.O. Box 456, Glen Waverley Vic. 3150. (03)232-0444.

## Decisions, decisions

**Microtrix will no doubt be proud to show you their Decision 1 computer, which utilises advanced IEEE-696 S100 boards from Morrow Designs.**

The CPU card is designed to function like an IBM 370 processor, features dynamic allocation of memory in 4K increments to 1 M, supervisor control of use, sophisticated trapping mechanism and an optional floating point processor.

The DMA floppy disk controller implements full DMA to IEEE-696 specs, using an on-board Z80A to supervise operations. Memory and I/O mapped controllers are also available, as is a DMA hard disk controller.

A multi-user, multi-tasking oper-

ating system (Micronix) is designed to operate on the Decision 1 with hard disks, and is claimed to be functionally equivalent to Bell Lab's UNIX. A CP/M emulator is provided, allowing use of all CP/M programs, it is claimed. Up to 15 users can be supported.

You can get 64K static RAM cards, I/O cards and hard disk drives of various capacities. Further details from Microtrix, 75 Grand Boulevard, Monmorency Vic. 3094. (03)439-5257.

## New single-board computer

**Table Top Systems has just released the AC-85 Single Board Computer, designed as the heart of a small business micro system.**

The AC-85 provides the expert hobbyist and the forward-looking end-user with a low-priced entry into computers, Table Top claim.

On a single 220 x 330 mm board the user will have available a 10 MHz 8085 A-Z CPU; 64K of dynamic RAM (300 ns); 2K EPROM bootstrap monitor which, after start up, is replaced by RAM; three RS232C serial channels with software selectable Baud rates; double or single density 8" floppy disk controller with DMA, capable of operations with up to four Shugart 801 or 851 D (or equivalent) disk drives; a real time clock; CP/M configured ready to run; fully assembled and tested plus full back-up service and 30-day

factory warranty.

The AC-85 has been designed to allow users to take advantage of the large amounts of software written for the CP/M operating system. Table Top Systems claim they can supply all CP/M software that the user might need to fulfil his requirements.

All that is needed to turn the AC-85 into a complete system is: a power supply; disk drive(s) and associated power supply; RS232 terminal and printer.

The AC-85 costs \$1495, plus tax, and is available from Table Top Systems, P.O. Box 32, Toongabbie NSW 2146.

## Club Call

**The Microcomputer Society**, P.O. Box 580, Fortitude Valley Qld. 4006, meets on the second Friday of each month at the Old Town Hall, cnr. Vulture and Graham Sts, South Brisbane. Meetings start at 7.30 pm — doors open around 7 pm, and if the main gate is closed use the back stairway! Parking is available and visitors are always welcome. Contact the Secretary at the above address, or phone (08)356-6176.

Special interest groups of the Society include:

- **The TRS80/System 80 Interest Group**, which meets on the first Sunday of each month at 21 Rodney St, Lindum, at 2 pm. Phone 396-2998 for more information.
- **The Apple II Brisbane User Group** meets on the third Sunday of each month at the Hooper Education Centre, Kuran St, Wavell Heights, starting at 8.30 am and running till 4.30 pm, with a break for lunch — bring your own food to barbeque. For more information contact Graham Hannam on 398-9405 or Peter Newland on 396-6072.

**1802 Users Group**: for those who own an ETI-660 or a COSMAC VIP, you can contact the 1802 Users Group at P.O. Box 6210, Auckland, New Zealand. Be kind and send them a return-addressed envelope and some IRCs.



# Print-out

## Cromemco personal computer

**Adaptive Electronics Pty Ltd recently announced that Cromemco has released a new powerful low-priced personal computer.**

The Marketing Manager of Adaptive Electronics, Mr. Adam Gatt, says that the Cromemco C-10 is perfect for the serious personal computer user, for the executive workstation, for distributed data processing or as a front end for a mainframe computer.

Starting at US\$995, the new C-10 is based on the industry-standard high-speed Z80A microprocessor and has 64K of internal user-accessible RAM and 16K of internal ROM.

The C-10 comes with an integral intelligent high-resolution 12-inch CRT with a detachable, light and easy to use keyboard. It also has a wide range of peripherals available, including floppy disk drives and a new low-priced (US\$895) letter-quality daisy-wheel printer.

Mr. Gatt envisages that the most

popular configuration for the C-10 will be the special Super Pack, referred to as the C-10SP. This system configuration consists of the basic C-10, keyboard, 390K capacity 5¼" floppy disk drive, along with a CP/M-compatible operating system, 32K structured BASIC, word processing and financial spread sheet software.

Besides access to the entire range of other Cromemco products (such as FORTRAN, COBOL and RAT-FOR), because of its CP/M compatibility the C-10 gives the user access to the widest possible range of microcomputer software products available.

The new Cromemco personal computer is available from Adaptive Electronics Pty Ltd, 418 St Kilda Road, Melbourne Vic. 3004. (03) 267-6800.

## Solve Rubik's cube on your ZX81

**Now you can enlist the help of your ZX81 to solve that modern madness — Rubik's cube!**

Gloster Software have a cassette program for ZX81/cube owners claimed to provide instructions much easier to follow than the 'how to do it' books.

You tell the computer what colours are on your cube and where the various pieces are now and the computer displays the moves in easy-to-follow steps by reference to the colours.

Instructions are said to be more explicit and relevant to the actual cube being used and to its current state. The usual direction-based abbreviated moves are replaced by, for example:

YELLOW HALF TURN

RED ¼-TURN

BLUE ¼+TURN

ORANGE ¼+TURN, etc.

While to some it may seem that the

challenge has been taken out of the cube, the computer adds another dimension by informing the user of the time taken to order the cube (excluding the computer's thinking time).

For those who are still unable to resolve the problem, the computer has a final word of advice. Noting that there are 43 252 003 274 489 856 000 combinations, it reasons that the cube owner now possesses a uniquely ordered cube. It therefore strongly advises the use of glue before some smart alex tries to arrange it to the same pattern on millions of other cubes!

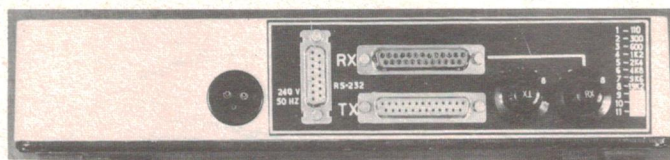
The program is on cassette and available from Gloster Software for \$9.50. Further details from Gloster Software, GPO Box 5460cc, Melbourne Vic. 3001.

## Scoring schizophrenia

**Pacman, the latest rage in video games, develops screen schizophrenia if you score too highly — according to a report from the US.**

One Eric Schwibs, an 18-year-old computer science student of Buffalo, New York, racked up around 3 million points after a whole night of continuous play on a Bally-made Pacman video game, whereupon the screen image split in two — the left side showing the Pacman maze, the right showing a confused jumble of numbers!

On reaching 935 590 points (Pacman only scores to six digits), the game reset to zero and Schwibs was off again. He again reached 935 590 points and it reset, but on doing it the **third time**, apparently the machine just couldn't take it, the screen split and refused to play further. Pacman packed it in.



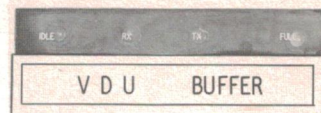
## CSIRO produce 'universal' interface

**A microprocessor-controlled, variable speed, serial into serial and parallel out buffered interface for computing equipment has been developed by the CSIRO Division of Applied Physics.**

There are many situations where an interactive computer (or data transmission device) is slowed down because of the slow peripherals it is attached to. Throughput can be increased if the transmission speed is upgraded. Usually it is a simple matter to upgrade the computer's rate, but not necessarily that of the peripheral because of its mechanical restrictions and response.

The buffer consists of a memory large enough to accept one page of data from a typical VDU screen (1920 characters). This is expandable to 8000 characters. Data are received at a preselected rate and are stored in the buffer. The data are then sent out to the peripheral at another preselected rate. For the 110 baud or 300 baud rate, there is an automatic insertion of a delay after the transmission of a carriage return character to allow for the carriage to return to the left hand margin. The transmit rate can be lower, higher, or the same as the receive rate.

A microprocessor incorporated in the buffer controls the reception, storage and transmission mode, annunciators, handshake, memory test upon power-up and various other aspects of its performance. When first switched on or after alteration of rate setting, the microprocessor transmits to the peripheral the baud rate which it has been set at. This is to ensure that the communication link is correctly set up. If the buffer fills up during operation, it inhibits the computer from sending any more characters until the buffer



empties again. It also puts out a half-second beep tone to bring attention to the operator, and illuminates the FULL annunciator.

The versatility of this buffer is enhanced because of its dual outputs, serial and parallel, each with its own handshake lines. The two outputs cannot be used simultaneously. Availability of a parallel facility allows a computer to send serial data to a distant peripheral fitted with a parallel interface only.

General specifications are as follows:

- Communication speed 110 baud to 19.2 kilobaud
- 2K buffer memory expandable to 8K
- Receive and transmit speed completely independent
- Automatic insertion of delays for slow peripherals
- RS232 levels for serial input and output (data, RTS)
- TTL levels for parallel output (data, busy/ready, strobe)
- Memory test and baud rate factor transmission on power-up
- Optional XON-XOFF facility
- Approximate size (mm) 270 W x 170 D x 55 H

Further details can be obtained from A. Bendeli, CSIRO Division of Applied Physics, National Measurement Laboratory, P.O. Box 218, Lindfield NSW 2070. (02)467-6211.

## Softalk

**One of the most informative magazines we've seen recently is 'Softalk', aimed specifically at Apple owners.**

It is published by Softalk Publishing Inc in California, and distributed here through Imagineering in Sydney. It is chock-a-block with programming notes and techniques, news, reviews and 'how to' articles — not to mention some very tantalising advertising. Well worth a look. Pop into your nearest Apple dealer and ask for a copy. It should be worth every penny you spend — and then some.



You're probably solving this sort of problem by pulling out an analysis pad and drawing up a spreadsheet by hand – taking your budget and recalculating every value in a series of columns – then checking them. If you're lucky you have a programmable calculator to help.

Here's what you should be doing: Multiplan running on a personal computer replaces pencils, paper, erasers, calculators and endless manhours in modelling, estimating and planning activities. Like the example here: if your sales tax rate is 17.5%, you simply put that figure at the top of the sales tax column – Multiplan calculates each product's sales tax value. If a price changes or the tax rate changes, you change one number – Multiplan changes the rest. You see all the results on a spreadsheet 63 columns wide, 255 rows deep and pages thick.

Multiplan is a computer program for non-computer people. Multiplan lets you assign names to cells or areas such as 'sales' or 'expenses', then lets you refer to that name in future formulas. On Multiplan you

# Mr Howard increases sales tax by 2%.

## How does this affect your company's profits?

### 15 seconds to answer.

can have a formula like:  
**Profit = Sales – Expenses**  
 On other spreadsheet programs that would look more like:  
**Profit = R1C3 – R5C12**  
 Multiplan is also the only

spreadsheet program capable of colour operation and there are none of the problems with forward reference handling that can cause other programs to give completely spurious answers. Multiplan lets you access data on other spreadsheets and allows multiple windows on the screen so you can see the effects of new entries on other parts of the sheet.

**A friendly system.** Multiplan is specifically designed to eliminate the routine and tedious tasks associated with forecasting, modelling and planning. In designing the program, Microsoft, the world's largest producers of personal computer software, aimed to provide users with an easy-to-use tool which maximizes executive thinking time while minimizing the time required to learn and use the system productively.

Multiplan is available right now for use on Apple™ computers, and will soon be available for use on the Osborne 1™ and standard 8" CP/M™ computers. Versions for other computers are under development.

Call into your nearest computer store and see Multiplan in action – your next forecast need only take you 15 seconds instead of hours.

# Multiplan

## from MICROSOFT

Apple II version:  
 \$295  
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For the name of your nearest Microsoft dealer or more information on Multiplan contact:

**Wiser-Microsoft**  
**PO Box 95, Forestville 2087. Ph (02) 451 9445**

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DELUXE MODEL	15.00	50	750.00	450.00	300.00
STANDARD-CHROME	12.00	75	900.00	540.00	360.00
BASE TYPE	8.00	120	960.00	576.00	384.00
OPTION PA	30.00	10	300.00	180.00	120.00
EXPORT TYPE	12.00	20	240.00	144.00	96.00
SPEC INPUT	16.00	10	160.00	96.00	64.00
DISPLAY PKG	15.00	10	150.00	90.00	60.00
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Simulated screen

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STD MODEL	10.00	5.00	.86	3.00	.25	1.20	703.20	493.20	29.86	210.00
DELUXE MOD	20.00	11.75	1.75	6.00	.50	.86	1810.50	709.50	29.78	301.00
STD-CHROME	15.00	8.81	1.31	4.50	.30	2.64	2325.84	1613.04	30.65	712.80
BASE TYPE	8.00	4.70	.70	2.80	.10	69.46	32646.20	25009.60	30.55	7640.60
OPTION PA	30.00	17.62	2.62	9.00	.60	.57	1004.34	696.54	44.19	307.80
EXPORT TYPE	12.00	7.05	1.05	3.00	.20	2.81	1981.05	1194.25	39.71	786.80
SPEC INPUT	16.00	9.40	1.40	4.80	.25	7.24	6805.60	4669.80	45.73	2175.80
DISPLAY PKG	15.00	8.81	1.31	4.50	.30	3.22	2836.82	1967.42	44.19	869.40
HEAVY DUTY	30.00	17.62	2.62	9.00	.60	.74	1303.88	904.28	44.19	399.60
SPEC DISPL	17.00	9.99	1.49	5.20	.42	1.92	1918.08	1365.12	28.82	552.96
TOTALS							52495.51	38618.75		13816.76

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# Beating the RS232 blues

A serial interface should be the simplest way to connect two pieces of computer gear together. Unfortunately, RS232 complicates matters.

Graham Wideman

ONLY TWO pieces of wire are needed to allow one computer device to talk to another, and three if you want a two-way conversation. So you would think that hooking together computer equipment with serial interfaces would be easy — provided, of course, that the various equipment manufacturers had adopted a standard for their interfaces. And herein lies a problem.

The 'standard' which was adopted for serial interface was one known as 'RS232'. RS232 is a standard of the American Electronics Industries Association, and was originally intended for the interface between 'Data Terminal Equipment' (DTE — in other words a computer 'dumb' terminal) and 'Data Communications Equipment' (DCE — equipment which facilitates communication to a remote computer, like a modem).

The standard specifies the electrical characteristics of the interface signals, along with the shape and pin assignments of the connectors to be used. In addition there are certain other conventions which go along with this standard, like the commonly used data rates and formats.

Now, although it's possible to borrow the electrical and timing conventions from this standard, many aspects are ambiguous. As mentioned above, RS232 specifies two different 'sexes' of equipment, terminal equipment and communications equipment, each with their own sex of connector, and their own connector pin assignments. But the standard is now being applied also to computers, printers, plotters, digitising tablets, speech synthesisers and so on, which don't fall conveniently into the category of either sex. Consequently any particular piece of equipment has a more or less arbitrary sex assignment.

Furthermore, RS232 contains specifications for using its connectors and signals for a large number of different applications. Since today's equipment needs only the simplest of such arrangements, most of RS232's features are not used, and in fact merely add to the confusion as manufacturers arbitrarily select the few features they need for their interface.

OK, the fact that the interface is somewhat arbitrary on any particular piece of equipment would be compensated if the equipment manual told you how it worked. Not the case. In fact the description of how the RS232 interface works is *almost universally the worst described part of the manual*, ranging from extremely ambiguous to downright wrong.

This month I am going to describe the theory of how RS232 is supposed to work. In a following issue I will describe a test unit which will patch any two devices together, and monitor what they are saying. You may wish to build one, or borrow the principles to understand how to test an interface by some alternative method.

## The basics of a serial interface

There are many possible ways to make a serial communications 'channel'; RS232 is just one method. Let us examine serial interfaces in general, and see how RS232 implements the various features involved.

I should point out here that many of these features are not strictly a part of RS232, but are conventions which are used with it. The best way to declare something as a 'convention' is by referring to data on the ICs used to implement RS232 serial interfaces, namely the 'UART' which formats the data (such as the National 5303 and similar), and the 'line driver' and 'receiver' which actually send and receive the electrical signals on the serial cable (National LM1488 and 1489 respectively).

Suppose we are dealing with the simplest type of interface, one in which there is a 'sender' and a 'receiver', such as may be the case where a computer sends data to a line printer. Two wires connect the two devices, one wire being 'Ground' or zero volts, the other wire carrying the data.

## Ones and zeros

The first task is to decide how to represent the binary 'one' and 'zero' as

voltages. A TTL logic IC regards a voltage less than 0.4 V as a logic zero, and a voltage greater than 2.8 V as a logic one. A TTL output is not, for various reasons, suited to sending data down a long wire, so RS232 does things differently. A 'zero' is represented by a 'high' voltage between +3 V and +12 V (for some reason also called 'space'), while a 'one' is represented by a 'low' voltage between -3 V and -12 V (also called 'mark'). The range between -3 V and +3 V is undefined.

Next we must decide in what order and with what timing the bits are to be sent down the wire. RS232 calls the unit of data transmission a 'character', even though the data sent may not actually represent a character. A particular device may be set to transmit or receive 5, 6, 7 or 8-bit characters, with seven being the most common (because seven bits will represent the entire ASCII set of 128 characters), and eight the next most popular. These characters are sent *least significant bit first*. Using the scheme as I have so far described it, the letter 'B', which is ASCII 42 hexadecimal, or 66 decimal, would appear on the line as (see also Figure 1):

High low high high high high low  
(7-bit code)

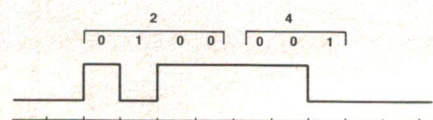


Figure 1. The letter 'B' (hex 42) represented as a sequence of voltage levels, as used by RS232 devices.

How does the receiver know when a particular character starts? We could use a third wire to signal that a character is starting on the second wire. This is a form of 'synchronous' communication, and is not used with any personal computer equipment. Instead RS232 has a way of telling the receiver that a character is starting. It works as follows.

## Start bit

Suppose the receiver receives the above letter 'B'. Normally the communications line sits at 'mark' or low. Along comes



bit one, which is a high, and immediately the receiver knows a character is coming in. Now, assuming that the receiver and sender are set so that they agree as to how long each bit is, the receiver will be able to recognise a high, then a low, then another low and so on, until the whole 'B' has been received.

However, suppose that instead the letter 'A' was sent, which is 41 hex, and therefore is represented (also see Figure 2) as:

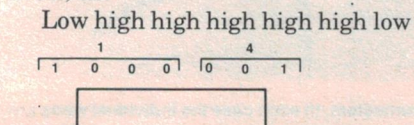


Figure 2. The letter 'A' (hex 41) represented in RS232 voltage levels.

This time, by the time the receiver finds out something is happening, it's already on the second bit! And what if you had a character composed entirely of lows?

The way around this problem is to prefix every character with a 'start' bit, which is invariably high.

## Stop bit

This still leaves one problem. Suppose we send several hundred characters in a row. It would be unreasonable to expect that the sender and receiver agree as to the time-per-bit to such great accuracy that they would still be in step after so many bits. To overcome this each character is suffixed with one or two (according to how the devices are set) 'stop' bits, which are always low. After each character we always have a low-to-high transition which can be relied upon to keep the two devices in step.

Notice that there is nothing particularly special about the start and stop bits. They look like any other bits, except that there is always a low-to-high transition at least once per character, and it's between these two bits. I point this out because it means, for example, that if you are sending serial data to a printer, if the signal is momentarily disconnected (transmission continuing but reception interrupted) then upon reconnection the printer will probably not be able to interpret the incoming stream of highs and lows. The printer will be confused until the next pause in transmission, unless the combination of received characters enables the printer to determine where the stop-start location is.

## Transmission speed: 'Baud Rate'

Naturally, both sender and receiver must be set to the same nominal communications speed. This speed is measured in bits-per-second, a unit also

known as the baud. (One bit per second is one baud.) Commonly used rates are: 110 and 133 (for Selectric terminals, for example), 300 baud (modems communicating via telephone), 600, 1200, 2400, 4800 and 9600 baud. Some devices also communicate at 19 200, 38 400 and even 76 800 baud, but such are rare.

## Parity

An embellishment which is occasionally seen is the use of 'parity' as an error checking method. In a seven-bit code, for example, an extra bit may be added after the last bit (but before the stop bit). The sender counts the number of 'one' bits in the character, and if the answer is even it sets the parity bit to 'one', if not it is made 'zero'. (This is the even parity convention. There's an equally little-used odd parity convention which makes the parity bit 'one' for an odd total.)

When the receiver gets the character it does the same arithmetic and compares its answers to the parity bit received with the character. If it has the same answer it knows all is well; if the answer is wrong an error has occurred somewhere. For example, suppose an 'A' is transmitted (seven-bit, even parity). This would be represented as in Figure 3.

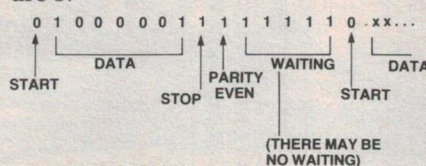


Figure 3. Representation of the letter 'A' in seven-bit even parity code. Note that a '1' is a low voltage and a '0' is a high. The line normally sits at low or '1'.

Now if one of those bits were accidentally changed somewhere along the way, there would be either one or three '1's, which is an odd number and does not agree with the parity bit. (And of course if the parity bit was accidentally changed, it wouldn't agree properly either.) You can probably see that this scheme cannot show where the error occurred or how to fix it, nor does it signal double errors. It is basically a low-overhead warning device.

In fact parity is generally ignored, since most personal computer equipment is not operated in electrically noisy environments where such errors are likely to occur, and in any case such equipment has no convention for requesting that the sender resend the faultily received data. (Often the receiving device may be set to expect the parity bit but not use it.) However, I have included this description so that you know what parity is when the equipment has a switch to select or deselect its use.

## Lots of options!

As you can see, even thus far there are plenty of options to choose from. In a typical device many of these options may be switch selectable, usually miniature DIP switches inside the box, or perhaps soldered jumpers. In some cases, such as terminals and computers, some of these features may be programmed from the keyboard or from software.

So there are plenty of ways in which your two little darlings won't be able to talk to each other! But wait, there's much more!

## How many duplexes?

Although not strictly of direct concern in the RS232 interface, some equipment, particularly terminals and modems, provide a 'Full/Half Duplex' switch.

'Full Duplex' means that when the terminal transmits a character to the remote computer the computer immediately echoes the character back to the terminal, whereupon it appears on the terminal's screen (or paper, if a teletype). If there is no echo then the character you typed will not appear on the terminal's screen. This is a kind of insurance method to let you know that the computer is listening.

In 'Half Duplex' set-ups it is assumed that the computer will not echo the characters from the terminal, and thus the terminal puts the typed characters on the screen whether or not the computer is awake.

The surprise comes if you have your terminal (or modem) set to Half Duplex, and the computer you are talking to echoes the characters. Then if you type 'FRED' you'll see 'FFREEDD'.

## Not so fast!

A commonly needed feature is the ability to tell the sending device to slow down. I don't mean to send at a lower baud rate, but rather to pause for a moment. A typical situation where this occurs is in slow printers. When the carriage reaches the end of the line the printer must tell the sender to wait until the carriage returns before sending more characters.

Such a signalling system is known as 'handshaking'. Typically this is implemented by adding an extra wire to the interface cable. The receiver maintains this wire at a 'high' signal level while it's OK for the sender to send, pulling it 'low' to tell the sender to halt the flow of data. Sometimes an interface will have handshaking lines both ways, so that either device can halt the other.

A complete two-way interface would consist of two data wires, two handshaking wires and ground — a total of five ▶



wires. Most RS232 hook-up problems occur because one piece of equipment needs some of these signals which the other does not provide, or because the wires in each piece of equipment are not connected to the corresponding pins in the interfacing connectors.

## Not so fast type two

A quick note here that on some intelligent printers handshaking is carried out using a method called 'X-on, X-off'. Instead of a separate handshaking wire, the printer has a data output wire (normally printers only receive data). If the printer wishes to halt the sender the printer sends a control character to the sender (usually control-S, hex 13, which is also known as 'Direct Control 3'). Subsequently sending the same character will restart the data. Note that this is the same character which you use in CP/M (and Apple) to stop and start a continuous display to the screen from the keyboard.

## Handshaking and buffers, etc

How necessary is handshaking in practice? A major sore point in the small computer industry has been the need for handshaking in printers. The Epson MX-80, for example, was available at one time with a serial interface known as 8141. This interface could only remember a maximum of two characters as they arrived from the computer. Since the 'line-feed' time exceeds the time of two characters, even at the slowest baud rates it was necessary for the interface to signal a halt after each line. The Exidy Sorcerer and the standard Apple printer interface board do not have any handshaking inputs, and consequently it would be impossible to make this combination of equipment work serially. (This particular problem rarely comes up since the MX-80 has a parallel input which is usually used. The Sorcerer has a parallel output, and the Apple has available for it a parallel printer board. I am simply showing how close to the surface such problems are swimming.)

A solution to this dilemma which is finding widespread adoption is to incorporate a 'buffer' into the serial interface. Such is the Epson 8145 interface, which has a 2000-character (approx.) buffer. Since the MX-80 chugs along at 80 characters-per-second (cps), if the computer transmits at 300 baud (30 cps) the buffer is normally virtually empty. At line-feed time the buffer fills up a little as the computer continues to transmit. But the MX-80 catches up on the next line. There is thus no need for handshaking. You can, however, get

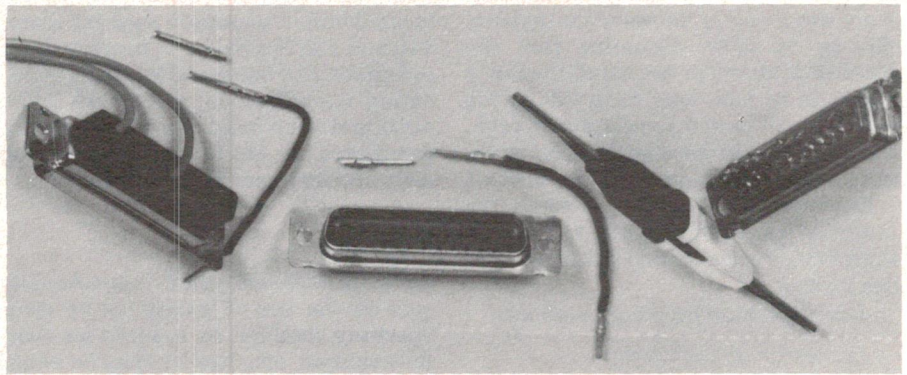


Figure 4. Photo showing two different styles of RS232 connectors. In each case the individual wires are soldered to the connector pins or receptacles.

To the left is a connector which comes with all the pins or receptacles permanently fixed in place; wires are soldered into 'cups' on the rear, which is the side in view here.

In the centre and to the right are shells which come 'empty', into which may be inserted male pins (into centre shell) or female receptacles (right). These can be more convenient, as the pins (shown separately and attached to wires) are easier to wire to before being placed in the shell, and in fact when installed are well separated by the shell (as can be seen in the rear view of the female connector on the right). The tool on the left is for the installation or removal of the male and female contacts.

In each case the connector may be bolted to a chassis, or put in a plastic cover for use as on the end of a cable.

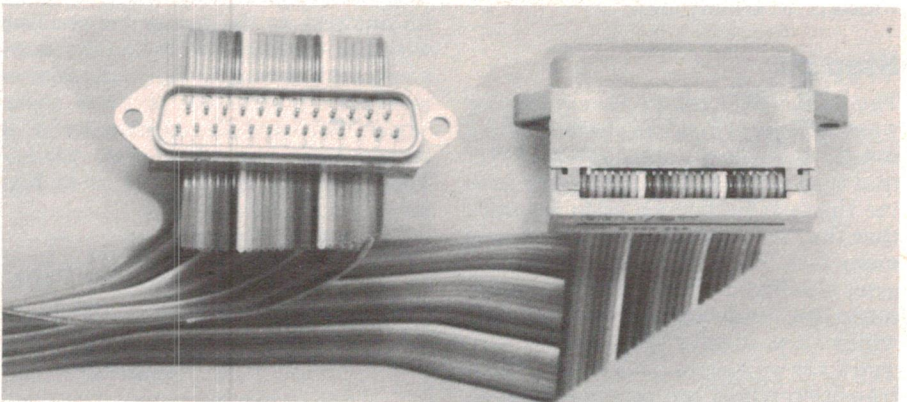


Figure 5. These are called 'Insulation Displacement Connectors' (IDC) and of course must be used with ribbon cable. They can only be used if it is desired to connect all 25 pins at one end to all 25 at the other. However, they are very easy to install; all that is needed is a small vice to squash the connector onto the ribbon.

into trouble if the computer sends a large number of form-feeds, which take a long time.

## Wires and connectors and stuff

The connector used with RS232 is known as a 'DB25', which has 25 pins in the male, and 25 receptacles in the female. Various styles are shown in Figures 4 and 5, with pin numbering shown in Figure 6. But why 25 pins?

RS232 was endowed with a pile of features not now used, and these were implemented using most of the 25 pins. Now very few of the pins are used. The extra pins provide two opportunities for confusion and problems, however. One problem is that with such a profusion of pins it can be difficult to figure out which ones you are supposed to use for your application.

'Business end' of male, or solder side of female.

1 2 3 4 5 6 7 8 9 10 11 12 13  
14 15 16 17 18 19 20 21 22 23 24 25

'Business end' of female, solder side of male.

13 12 11 10 9 8 7 6 5 4 3 2 1  
25 24 23 22 21 20 19 18 17 16 15 14

**IMPORTANT NOTE:** This numbering scheme means that with the IDC connectors the pin numbers do *not* correspond to the ribbon conductor numbers; 1 will be 1, but pin 14 will be ribbon conductor 2, etc.

Figure 6. DB25 contact numbering.

The second problem area is that with all those extra tantalising pins available and otherwise doing nothing, many manufacturers use the 'spare' pins for other purposes. Exidy uses them for the cassette interface. IDS, in their Paper Tiger printers, use the same DB25 for both serial and parallel interfaces.



'Official' Signal Name	Abbrev(1)	Pin No.	DTE 'Terminal'	DCE 'Modem'	Comments
Protective ground	PG	1	—	—	Optional
Signal ground	SG	7	—	—	Necessary
<b>Data:</b>					
Transmitted data	TxD	2	Out	In	
Received data	RxD	3	In	Out	
<b>Handshaking:</b>					
Request to send	RTS	4	Out	In )	Basically
Data terminal ready	DTR	20	Out	In )	same use
Clear to send	CTS	5	In	Out )	Basically
Data set ready	DSR	6	In	Out )	same use
<b>Connector Sex:</b>			Male(2)	Female	

(1) Note that the handshaking lines are sometimes indicated as inverted signals (e.g. DTR). The idea is that if for the data a low is a '1', then if the data terminal is ready it should send out a '1'. In fact it sends out a high, which corresponds to a zero, hence the desire to use inverted signal notation. This refers, however, to the identical signal. In contrast there is the rare occasion when the equipment actually does put out an inverted signal, i.e. low means ready, high means not ready. Yeah, I know, but don't complain to me!

(2) In fact almost all terminals use female chassis-mount connectors. (A notable exception is the Heathkit H19.) It seems that it is almost standard practice to use females on equipment chassis, and male on cables (except for much DEC equipment, which uses male chassis mounts on equipment, and female connectors on cables). Note that this means you can't tell the DTE/DCE gender from the sex of the connectors.

Another printer may claim to have the same handshaking output, but it is actually internally wired permanently high, and is provided merely for supposed compatibility to a computer which may need such an input so as not to halt. Got that?!

## Wiring up the cable

You will notice that if one of your units is a true DTE and the other a true DCE then a standard cable (pin 1 goes to pin 1, 2 to 2 and so forth, which is called a 'straight-through') will work. You are unlikely to see this situation very often, which is something you should know before you buy such a cable made up (they're likely to be expensive ready-made), or before you get convinced by the salesman that the printer hook-up is trivial.

So you decide to wire your own cable. First, of course, you must obtain the appropriate sexes of connectors to mate with what you have on the equipment, and a cable with a sufficient number of conductors. If it's over 20 feet you may wish to use shielded cable, but I've used unshielded up to several hundred feet. ►

Figure 7. Table of signals, what they do, and connector pin assignments.

That's fine except that if between such units you use a cable with too many wires implemented (and this can easily be the case if you use a standard RS232 cable in a set-up which does not use handshaking) then you are likely to blow something at one or both ends!

The pins which are commonly used are shown in Figure 7. Note that the naming convention can result in a variety of confusions. If the equipment is masquerading as a DCE the manual may tell you that, for example, pin 2 is 'Transmitted Data', which strictly speaking is an *input*. However, the manual writer may not know this and instead call it 'Received Data', intending 'Received' in a looser sense.

## Fighting back

The first thing to do before connecting *anything* is to make yourself a chart like the one in Figure 8 for each piece of equipment you may have to connect together. This is *especially* important if you are involved with many different units. I have a whole binder full of such charts on the equipment I work with. Using this binder I can almost instantly connect any two units with few problems.

The point to this chart is that for each of your pieces of equipment (and I assume you're working with at least two!) it serves to collect the titbits of information you will glean from the manuals, the schematic and so on. You end up with the info in the same format for each unit, where it can be simply compared to give you the best idea of how to wire things up *before* you blow anything, and before you have the frustrating experience of having the system not work.

If handshaking lines are provided, try to find out if they actually do anything, or if they are dummies. For example, one printer may have an output which signals the sending computer to halt.

PIN NO.	SIGNAL ABBREV.	SIGNAL NAME	IN/OUT	OPEN OK?	COMMENTS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

EQUIPMENT TYPE:

CONNECTOR SEX ON EQUIPMENT:

DATE:

Figure 8. Interface chart to save you headaches.



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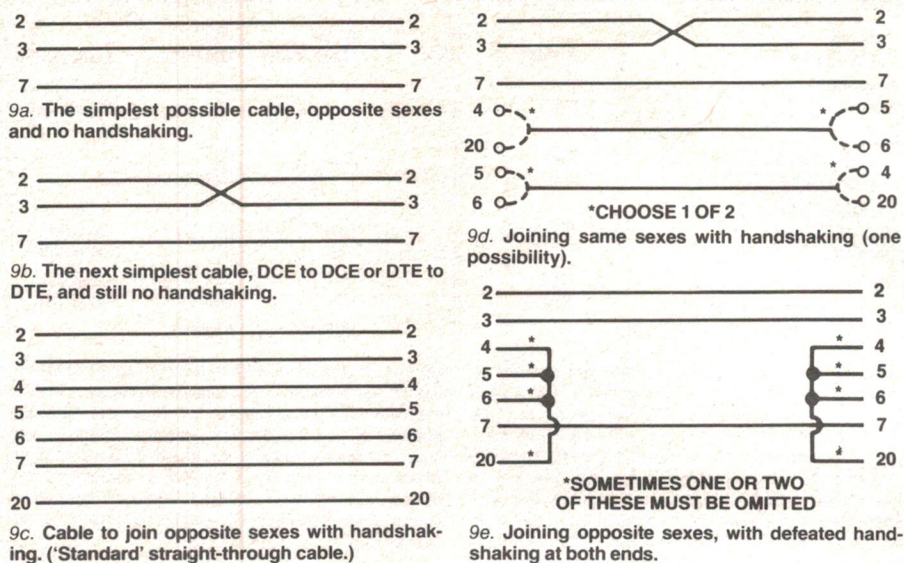


Figure 9. Some typical cable hookups.

Next, no matter what the equipment involved, wire pin 7 to pin 7. If it's a straight-through you are making, then go right ahead, 2 to 2, 3 to 3, etc.

The next-most-delightful situation is where the two units are of the same sex and need no handshaking lines. For the data lines simply wire 2 to 3 and 3 to 2.

If handshaking lines are needed then determine which handshaking outputs actually mean something (as opposed to the dummies). Then connect these to the handshaking inputs of the opposite units.

You may have a sender which is sending to a receiver which does not need to halt the sender. If this is the case you need to decide what to do with the sender's handshaking input. In some units it can merely be left open (unconnected), and this is seen as the same as 'high'. On other units open is taken as a 'low' and halts transmission. The handshaking input may be wired permanently high by jumpering it to a handshaking output on the same device. This is normally done inside the plug on that

unit's end of the cable. Figure 9 shows some typical cable configurations.

### The initial hook-up

Armed with the appropriate (we hope) cable, plug in and see if it works! It probably won't, so refer to Figure 10, which is a summary of all the things to check to make the two pieces of equipment compatible communicators.

### A test box to defeat all problems

So perplexing are some RS232 problems which I have encountered that I highly recommend obtaining a test unit of some kind if you are going to be involved with many such situations. In the next part of this article we intend to present details of a device which is designed to handle these problems, and which also permits quickly patching together any trial interface configuration. Unlike commercial units, it will even enable you to determine the inputs and outputs of a completely unknown interface with no documentation.

1. Number of **bits per character**: 5, 6, 7, or 8.
2. Number of **Stop bits**: 1 or 2.
3. **Baud Rate**: 110, 150, 300, 600, 1200, 1300, 2400, 4800, 9600 or other.
4. What to do with **Parity**:  
On transmission: No Parity, Even Parity, Odd Parity, Parity bit set to 0, or Parity bit set to 1.  
On reception: No Parity expected, Ignore Parity, Expect Odd, or Expect Even.
5. **Full or Half Duplex**.
6. Make sure machines are **On Line** if they have the ability to be off line.
7. A rather rare final item which can cause problems is an option on a few machines which allows for the inversion of the polarity of the data signals and/or handshaking signals. You should set these to: Negative Mark for the data lines, and handshaking lines should indicate OK to proceed with a high level, STOP with a low level.
8. What to do with a system which can't be made to work after all this is the subject of next month's article.

Figure 10. List of quick checks to make when hooking up two pieces of gear for the first time.



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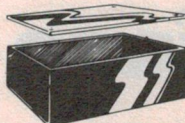
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MU6S 0-50uA	\$6.50	\$5.50
MU6S 0-50V	\$6.50	\$5.50
MU6S 0-20V	\$6.50	\$5.50
MU6S 0-1A	\$6.50	\$5.50
MU6S 0-1mA	\$6.50	\$5.50
MU6S 0-10A	\$6.50	\$5.50



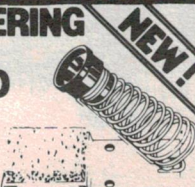
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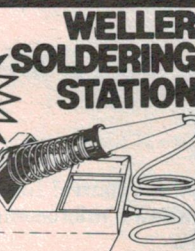
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IN4003	.06c	.05c	.05c	.05c
IN4004	.07c	.06c	.05c	.04c
IN4005	.09c	.08c	.07c	.06c
IN4006	.10c	.09c	.08c	.06c
IN4007	.12c	.09c	.08c	.07c

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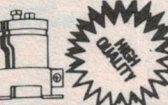
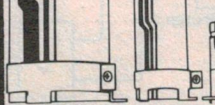
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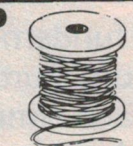
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# Turtle robot — interface fundamentals

**Allan Branch**

Flexible Systems, Hobart, Tasmania

This article covers the fundamental principles involved in interfacing the Minimum Turtle robot to a computer. A table of relevant interface connections for some popular microcomputers is included.

IGNORING SERIAL interfaces, parallel user data busses can be divided into three types:

a. Bidirectional (the most common on micros):

D0 I/O ↔  
D1 I/O ↔  
D2 I/O ↔  
D3 I/O ↔  
D4 I/O ↔  
D5 I/O ↔  
D6 I/O ↔  
D7 I/O ↔

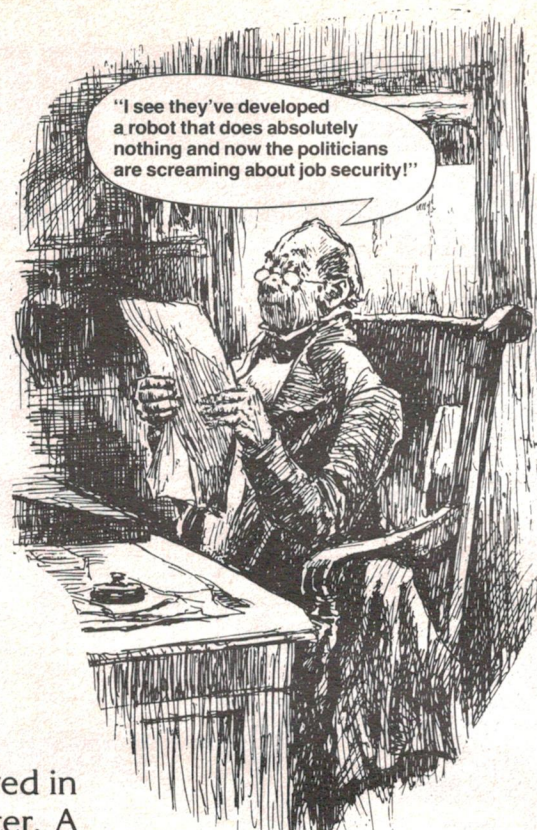
b. Unidirectional (e.g. S100):

DI0	←	DO0	→
DI1	←	DO1	→
DI2	←	DO2	→
DI3	←	DO3	→
DI4	←	DO4	→
DI5	←	DO5	→
DI6	←	DO6	→
DI7	←	DO7	→

c. Interface adapted PIA, VIA, etc (e.g. PET):

PA0	↔	PB0	↔
PA1	↔	PB1	↔
PA2	↔	PB2	↔
PA3	↔	PB3	↔
PA4	↔	PB4	↔
PA5	↔	PB5	↔
PA6	↔	PB6	↔
PA7	↔	PB7	↔

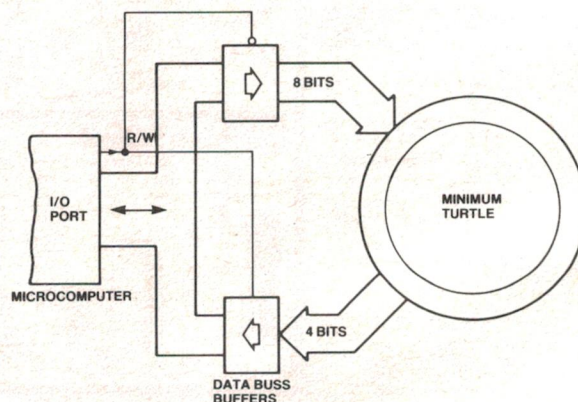
Each of these should be treated separately, since different circuitry is needed to interface each to the Minimum Turtle.



Complete interface circuitry is shown at the end of this discussion.

## Bidirectional data buss

The Turtle robot has separate in/out control lines, and these have to be suitably connected to allow a microcomputer with a bidirectional data buss to drive it.



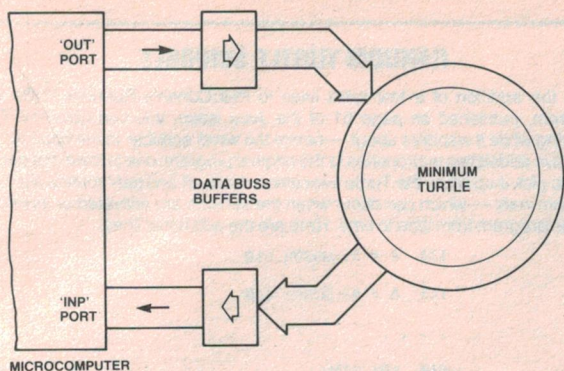
General interface technique where your microcomputer has a bidirectional I/O port.

Suitable high-impedance buffering controlled by the read-write signal from the microcomputer is the simplest way of facilitating this type of port.

## Unidirectional buss

This type of data buss is already configured appropriately for the Turtle. Buffering is still recommended, as the Turtle cable is a long parallel ribbon type.

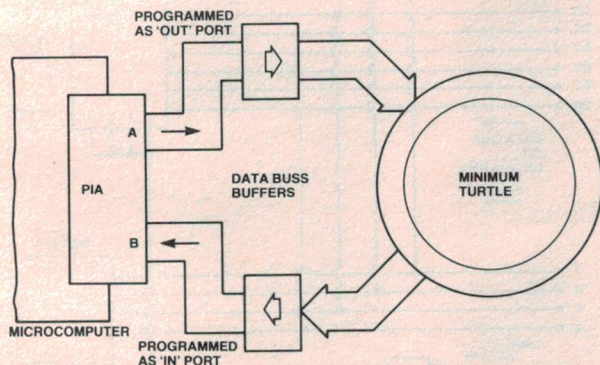




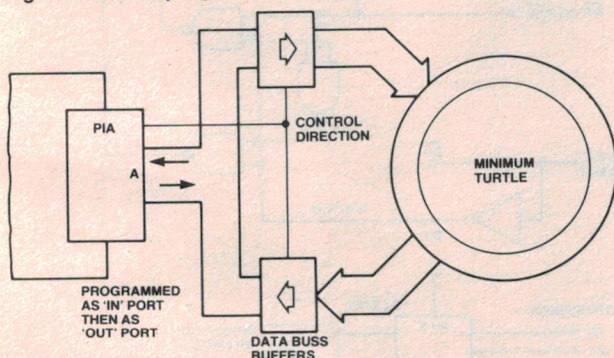
General interface technique where your microcomputer has a unidirectional data buss structure — one input and one output port.

## Interface adapted

Many semiconductor manufacturers supply special integrated circuits designed to support user parallel ports. These are called by various names, such as peripheral interface adaptor (PIA), variable interface adaptor (VIA), programmable peripheral interface (PPI), etc. They usually supply two or more eight-bit ports which can be configured in many different ways. Various registers within the IC control the direction of each bit of the port according to the data stored in them, and this data must be programmed prior to using the ports (e.g. ETI-685). These ports can take on the identity of both bidirectional and unidirectional ports with appropriate programming.



One method of using an 'interface-adapted' I/O scheme, where port A is configured as the output, port B as the input.



Another method of using an interface-adapted I/O. Here, one port is programmed first as an 'in' port, then as an 'out' port.

Although the configuration shown in Figure 4 would be slower and require more programming, some computers have a single PIA with one port already used (keyboard, cassette, etc), and only one port is available for the user (e.g. SYM).

## Device request

It is necessary for the Turtle to be 'called up' so that it knows what data to respond to and what to ignore.

Many computers provide a pin on their port called variously device request, device select, I/O request, peripheral enable, etc, and this can be used to address the Turtle directly. In some cases further addressing might be needed to supplement the device request signal.

Other computer ports have no special device request signal and one has to be generated from the address buss or some other means. The IEEE port, for example, uses the data buss for both data and address information. The ATN (attention) signal in this case calls up all peripherals (including the Turtle), and indicates that the data is actually an address.

## Read-write

Not only does the port have to address the Turtle and supply data, it also has to receive data from the Turtle sensors. The read-write signal at the port is used to indicate and control the direction of data flow.

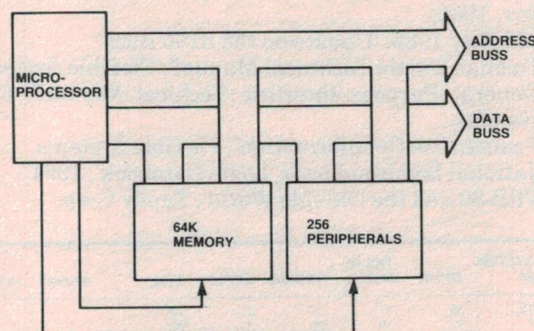
This signal can have various configurations, and is most often one of the following:

1. Read/write — a single line on which each polarity (0, 1) represents a direction of data flow.
2. Read — two lines, each activating one direction of Write — data flow.

The polarity (active high, active low) can vary, and with some microprocessors different signals for memory and peripherals can exist.

## Memory mapping vs. port based

Some microprocessors offer facilities to treat peripheral devices separately from the system memory.

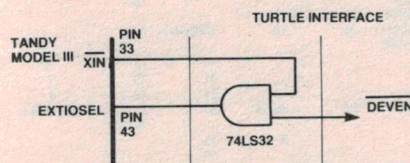


The user of these systems has the choice of allowing the Minimum Turtle to occupy part of memory space (by giving the Turtle a single address between 0 and 65536) or to let the Turtle be designated a particular peripheral number, called a port number. Different instructions in programming will then be used, depending on the choice (e.g. TRS-80).

In BASIC:

	Memory mapped	Port based
To Turtle	Poke (Turtle address), (data)	OUT (T.A.), data
From Turtle	Peek (Turtle address)	INP (T.A.)

On the Tandy Model III a special handshake is necessary:



The port then has to be enabled by a special OUT instruction (see Tandy manual).



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3. *Cognition and Reality*, Ulric Neisser, W.H. Freeman & Co.
4. *Computers and the Cybernetic Society*, Michael A. Arbib, Academic Press.
5. *As Man Becomes Machine*, David M. Rorvik, Souvenir Press.
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3. 'The PET Revealed', Nick Hampshire, 1980.
4. 'Dick Smith System 80 Technical Manual', issue no. 1, Nov. 1980.
5. ETI May 1980: 'Update on the S100 Buss'
6. 'Tasman Turtle Technical Manual', Flexible Systems.
7. 'General Purpose Interface Technical Manual', Flexible Systems.
8. 'Tasman Turtle Information', Flexible Systems.
9. National Semiconductor 'Logic Databook', 1981.
10. 'TRS-80 and the Outside World', Tandy Corp.

Table showing expansion connector pins and signals for various popular microcomputers.

**Suggested arrangement of an interface for the Minimum Turtle which can attach to any computer expansion interface that provides access to the appropriate lines. You can obtain 'device select' from a device select line or decode it from the address bus — hence the switch. Read and write signals are then gated with the device select to steer data in or out of the interface appropriately.**



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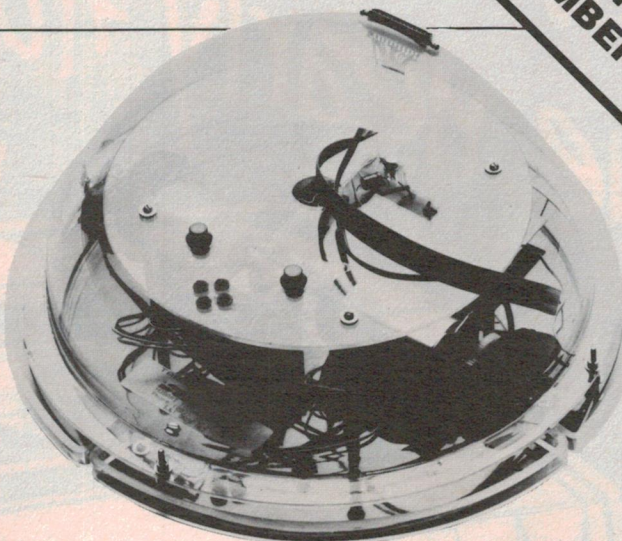
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The complete Minimum Turtle Kit comes ready for assembly according to the construction description published in ETI, packed in a box which has been designed so that the Turtle may be housed or stored in it after assembly.

### HOW TO PURCHASE A MINIMUM TURTLE KIT

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The orders will be processed by ETI and, on clearance of the cheque or money order by Flexible Systems, the kit will be despatched directly to you by ETI via registered post.

**Alternatively:** You may call in to ETI's Sydney or Melbourne offices at the addresses given below and purchase a Minimum Turtle Kit for \$349. A demonstration kit and/or model will be available for inspection during this offer.

**Sydney:** ETI, 4th Floor  
15 Boundary St  
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**Melbourne:** Murray Publishers, 22nd Floor  
150 Lonsdale St  
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**Tax exemption:** For schools, TAFEs, etc. this kit can be purchased at the tax exempt price **only** if the coupon is accompanied by a signed order and a tax exemption declaration.

**NOTE:** This offer is made by Flexible Systems in co-operation with ETI Magazine. ETI is acting as a clearing and despatch agent for orders. All mail orders will be despatched by registered post. Please allow four to six weeks for delivery.

### DEMONSTRATIONS: see the Turtle — live!

**Sydney:** at ETI's office, 4:30 — 6:00 pm, Monday to Thursday.

Apple II computer supplied for demonstrations courtesy Imagineering Pty Ltd.

**Melbourne:** at city office, by appointment.

Apple II computer supplied for demonstrations courtesy Computer Country Pty Ltd.

### WHAT YOU CAN DO WITH IT

You can use your Minimum Turtle to experiment with many aspects of robotics by interfacing it with a computer: draw figures under program command, solve mazes, make measurements, identify objects, etc. It can be driven via a cable or a remote control. The Minimum Turtle has been designed so that a wide variety of add-on projects may be included to increase the sophistication as you desire.

### THE MINIMUM TURTLE KIT CONTAINS:

- All hardware (base, nuts and bolts, perspex dome, 'touch' ring, pen solenoid, speaker, etc)
- All mechanical parts (wheels, gears, axles, two stepper motors, etc)
- 'Standard Turtle' electronic control pc board and components
- All wire and cable for internal wiring
- A 25-pin plug for bidirectional data buss, control lines and power supply connections
- Comprehensive instruction manual

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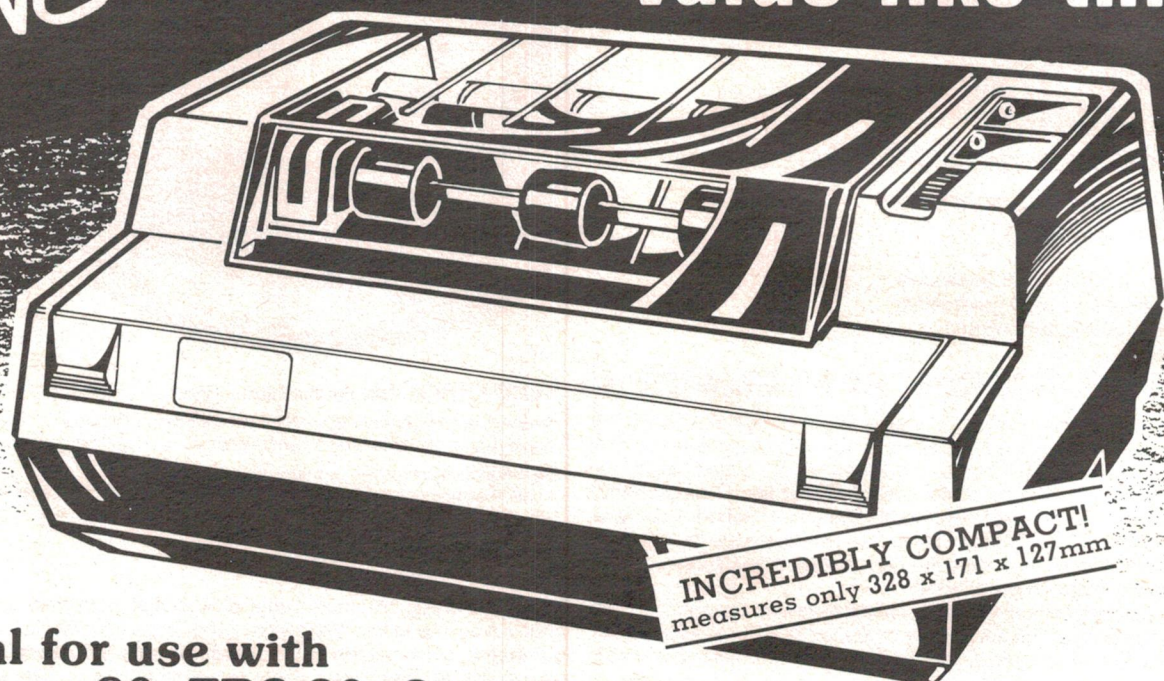
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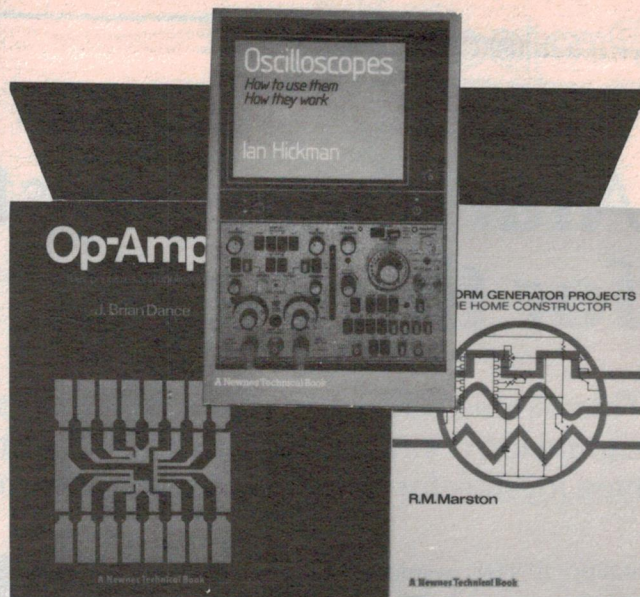
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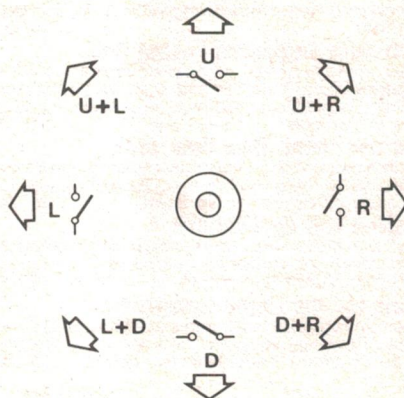


# Atari-type joystick interface for the System 80

This simple add-on interface attaches to the System 80 expansion connector and permits attachment of an Atari-type joystick for graphics or games control.

**Geoff Nicholls**

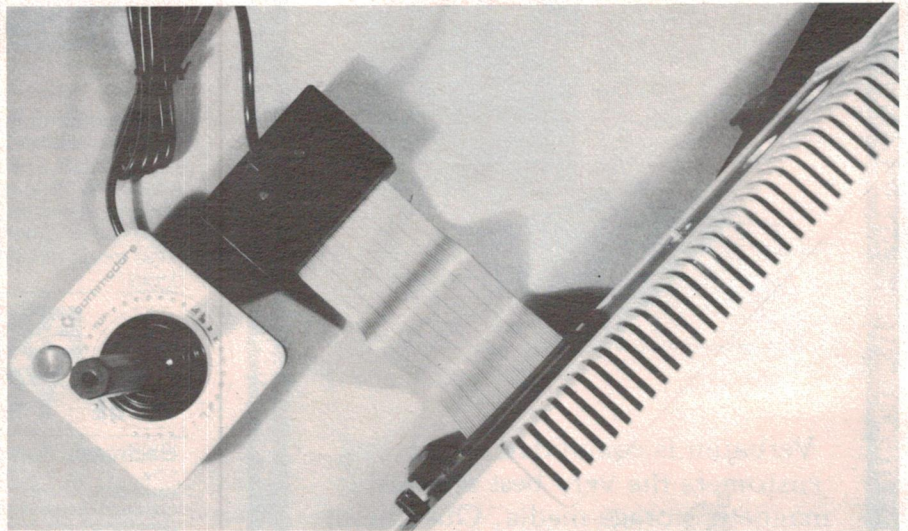
SOME OF THE popular cassette-based software suitable for the System 80, such as that by Big Five and Adventure International, calls for an Atari-type joystick input for controlling on-screen objects. This type of joystick has four switches arranged orthogonally and activated by a vertical shaft which is kept in the upright, or 'neutral', position by a rubber boot. You grasp the shaft with one hand and the base of the unit, containing the switches, with the other. Angling the shaft in any direction then activates a switch or combination of switches to indicate the direction of shaft movement. Eight directions can be indicated:



The 'directions' indicated by movement of the joystick shaft.

A button in the joystick base can be activated by the thumb to give another function — usually a 'write' or 'fire' function (as in games involving missiles, etc).

These joysticks first appeared with Atari TV games and latterly their home computers. The same type of joystick is available, under the Commodore label, for the Commodore VIC-20 home computer. Dick Smith lists the latter in his catalogue, No. X-2020, for \$19.95.



The interface simply attaches to the System 80's expansion connector at the rear of the machine.

As it stands, the joystick is a '5-bit' device — four 'direction' bits and one 'fire' bit. Some joystick software requires '4-bit' input. In this instance, the U and D switches are paralleled by the fire button. A slide switch provides for both 4-bit and 5-bit modes of operation.

The interface is powered from the System 80.

## Construction

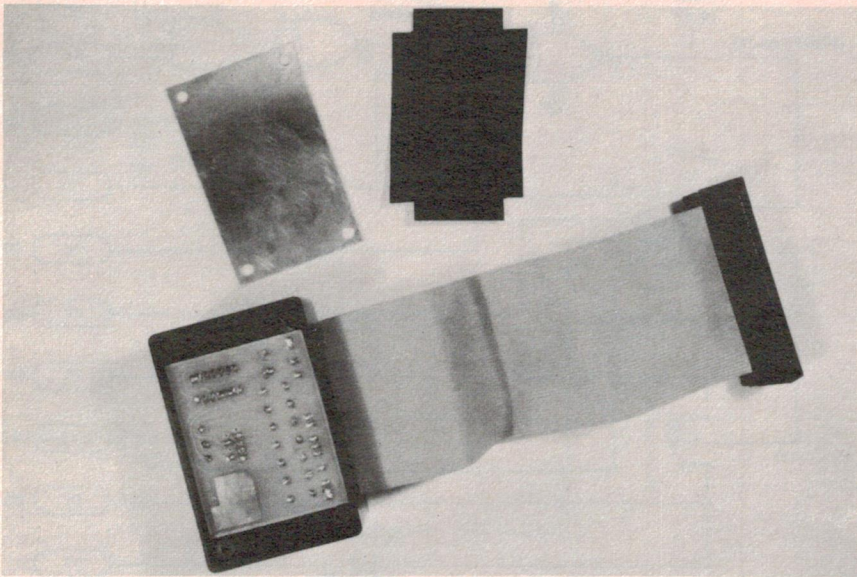
We recommend you use our pc board design as it simplifies construction and reduces the possibility of wiring errors. We fitted the pc board into a 28 x 54 x 83 mm jiffy box (Dick Smith catalogue No. H-2755). The 9-way chassis-mount plug for the joystick connector and the 5-bit/4-bit slide switch mount on the plastic base of the box (which now becomes the 'top'). Connection to the System 80 expansion interface is via a 50-way edge connector and a length of 50-way ribbon cable that passes through a slot cut in the side of the jiffy box to the pc board mounted inside.

Construction should commence with drilling and cutting the various holes in the jiffy box. Take your 'empty' pc board and, using it as a template, copper side down, mark the approximate position of the 9-way chassis-mount DB plug on the outside of the jiffy box bottom. Mark out the required hole for it and its two mounting screw holes, then mark out a suitable position for the slide switch slot, on the side opposite the 9-way plug. Drill out all of these and carefully file the 9-way plug hole and slide switch slot to shape so that both components fit nearly — *from inside the jiffy box*. A slot for the ribbon cable is cut in one side of the box. Drill a line of small holes and file the slot edges flat.

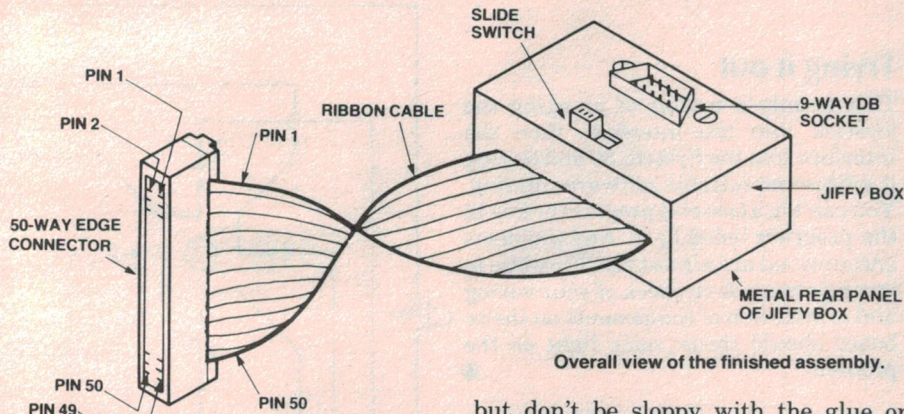
Before mounting the 9-way plug, solder 50 mm lengths of 22 gauge tinned copper wire to pins 1, 2, 3, 4, 6 and 8. These should drop straight down from the plug pins. Next solder a 75 mm length of three-way ribbon cable to the pins of the slide switch. Now both the 9-way plug and the slide switch may be mounted in the box. Bolt the 9-way plug in place. We glued the slide switch in —



# joystick interface

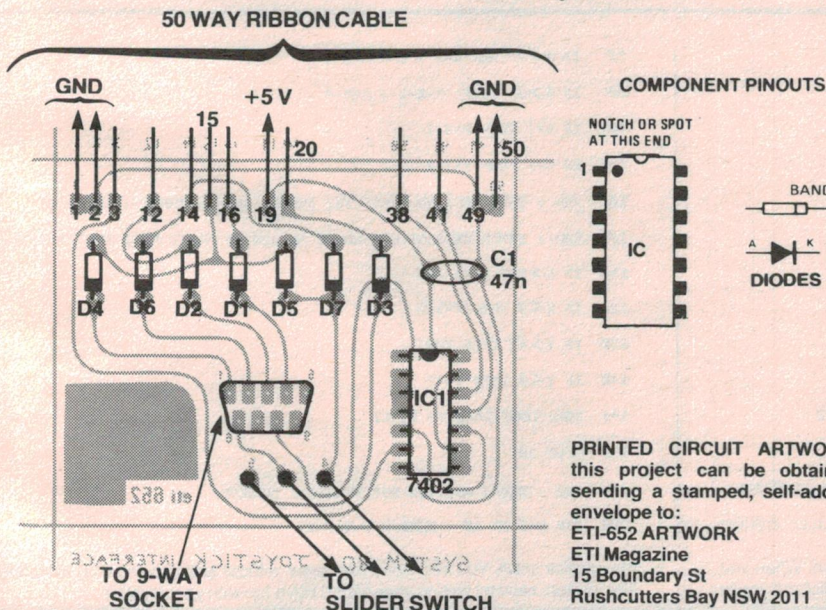


The pc board is held inside the jiffy box by the metal panel. Note the piece of insulating material that goes over the back of the board to prevent shorts.



Overall view of the finished assembly.

but don't be sloppy with the glue or you'll gum up the switch! Five-minute epoxy is very handy here, and is used later, as you shall soon see.



Make up the ribbon cable and edge connector now. We used a 50-way edge connector that 'crimps' on the end of the cable, making contact to the wires without the necessity of stripping the insulation by means of special pins on the connectors. The other end of the ribbon cable is fed through the slot in the jiffy box for 50 mm or so. Identify the wires to be soldered — 1, 2, 3, 12, 14, 15, 16, 19, 20, 38, 41, 49, 50 — and cut back the unused wires about 25 mm. Strip the ends of the remaining wires about 5 mm and tin them. Put the box assembly aside for the moment.

Now the pc board can be assembled. The diodes, capacitor and IC can be assembled in any order — just watch the orientation of the semiconductors.

Having completed that, the ribbon cable can be soldered to the board — make sure the wires are in their correct places, though. It's worth a double check. The pc board has been laid out to make this part of the job relatively easy, however. Now wire in the slide switch. Adjust the ribbon cable such that the full 50 wires (i.e. the uncut section) protrude through the inside of the box about 15 mm or so. Run a bead of five-minute epoxy along the cable right at the slot.

After the epoxy has set, put 10 mm lengths of spaghetti insulation over the tinned copper wires on the 9-way plug. Feed the wires through the correct holes in the pc board (which should be pretty well beneath the socket when lined up to go in the box) and push the board into the box. Straighten the wires by pulling them gently with pliers and solder each of them. Cut a piece of thin cardboard or plastic to fit over the rear (copper side) of the pc board to stop the metal lid from possibly shorting the tracks. Put this in place and secure the lid.

## PARTS LIST — ETI-652

### Capacitors

C1 ..... 47n greencap

### Semiconductors

D1-D7 ..... 1N4148, 1N914 etc  
IC1 ..... 7402

### Miscellaneous

ETI-652 pc board; UB5 jiffy box (28 x 54 x 83 mm) or similar; 50-way edge connector socket; 300 mm length of 50-way ribbon cable; 9-way DB plug, chassis-mount, to suit joystick line socket connector; SPDT slider switch; nuts, bolts, glue etc.

**Price estimate**  
**\$35 — \$40**

(includes joystick)

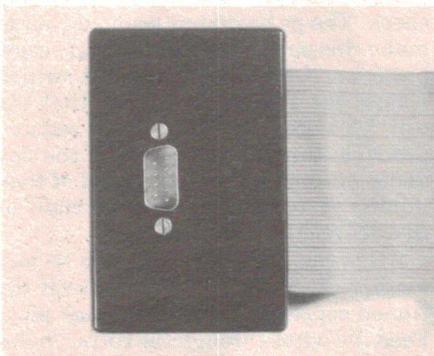


# Project 652

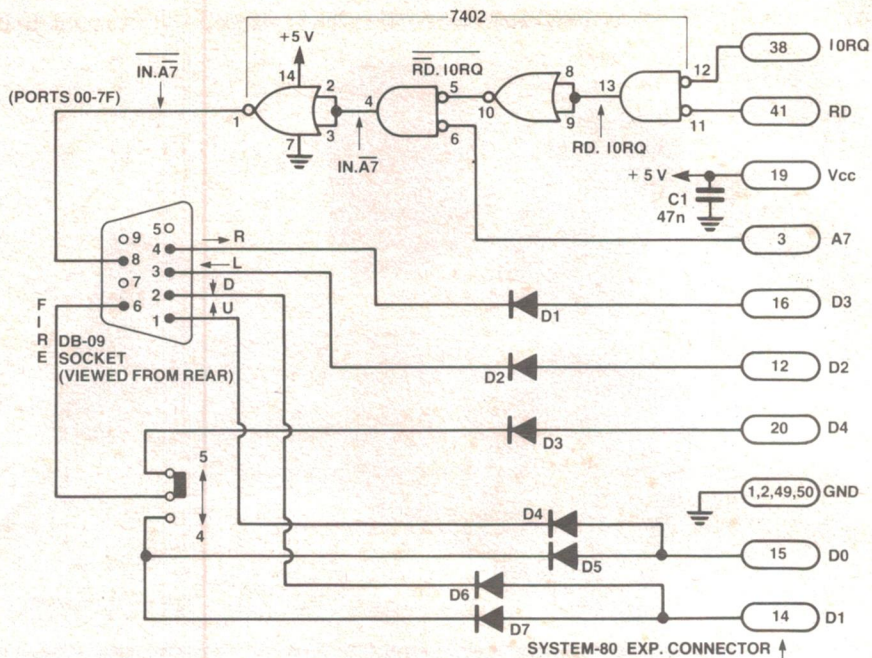
## HOW IT WORKS — ETI-652

The joystick unit itself comprises four direction switches and a fire switch in a square, shallow case, operated by the stick which you grasp in your hand. A cable and 9-way plug provides connections. When a switch is activated, it connects one of the pins 1, 2, 3, 4 or 6 in the plug to the common line — pin 8. The five switches are encoded into either four or five data bits according to the position of switch S1. The five-bit mode connects each switch to a separate data line. The four-bit mode indicates the fire switch by activating the UP and DOWN line simultaneously, via diodes D5 and D7. The four-bit mode is provided to ensure compatibility with early joystick software.

The System 80 data buss is pulled high by internal resistors. The joystick therefore uses an active low to indicate a key closure. IC1, a quad NOR gate, decodes the control signals IORQ, RD and address buss bit 7 to make the interface appear to the computer as an I/O device occupying input ports 00 to 7F. This leaves 128 input ports free for other purposes. When the computer executes an INPUT instruction within the range 00 to 7F, pin 1 of IC1 goes low and allows the data buss lines to be selectively pulled down via the joystick switches and the diodes, which prevent the buss from being affected when the joystick interface is not selected.



View of the completed interface. Note orientation of the 9-way DB plug and location of the slide switch.

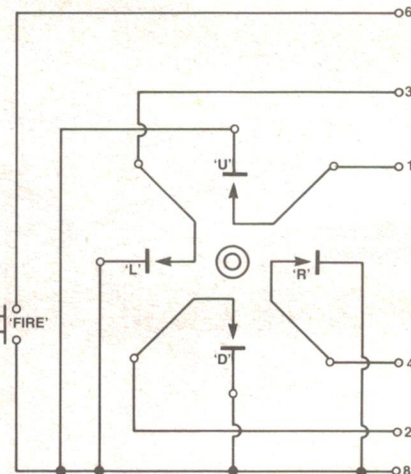


Circuit of the interface.

## Trying it out

This is only a matter of plugging the joystick into the interface, then the interface into the System 80 and testing it with some suitable software running. You can try a cassette program or key in the program listed here. Any problems encountered are almost certainly due to wiring errors. A re-check of your wiring and orientation of components on the pc board should throw some light on the problem.

Circuit of the joystick showing pin connections on the 9-way line socket.



## JOYSTICK DEMONSTRATION PROGRAM

```

5  REM: POSITION CURSOR IN CENTRE
10 CLS: X=63: Y=23
15 REM: READ AND INVERT JOYSTICK
20 A=255 - INP(0)
22 REM: SET POINT UNLESS FIRE BUTTON ON
25 SET(X,Y)
30 IF A > 15 THEN RESET(X,Y): A=A-16
35 REM: FLASH CURSOR ONCE, BUT LEAVE IT THE SAME
40 C=POINT(X,Y)
50 IF C=0 THEN SET(X,Y): GOSUB300: RESET(X,Y): GOTO 70
60 RESET(X,Y): GOSUB300: SET(X,Y)
65 REM: THIS SECTION UPDATES CURSOR POSITION ACCORDING TO JOYSTICK
66 REM: DIRECTION. IF JOYSTICK IS IN CENTRE A=0 AND IT FALLS THROUGH

```

```

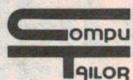
70 IF A > 7 THEN X=X+1: A=A-8
80 IF A > 3 THEN X=X-1: A=A-4
90 IF A=2 THEN Y=Y+1
100 IF A=1 THEN Y=Y-1
105 REM: THIS SECTION WRAPS THE SCREEN AREA AROUND TO AVOID AN
106 REM: ERROR MESSAGE CAUSED BY AN OUT OF RANGE PLOT INSTRUCTION
110 IF X > 127 THEN X=0
120 IF X < 0 THEN X=127
130 IF Y > 47 THEN Y=0
140 IF Y < 0 THEN Y=47
145 REM: LOOP BACK TO START
150 GOTO 20
295 REM: DELAY ROUTINE FOR FLASHING CURSOR
300 FOR N=1 TO 20: NEXT N: RETURN

```

This program puts up a flashing cursor in the middle of the screen. When you move the joystick the cursor 'writes' according to the direction in which you move

the joystick shaft. You can move the cursor without writing by holding down the 'fire' button. Now try writing your name! Have fun with your joystick.





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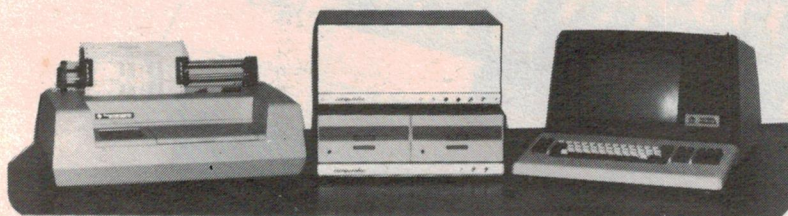
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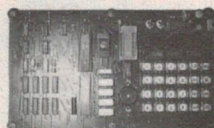
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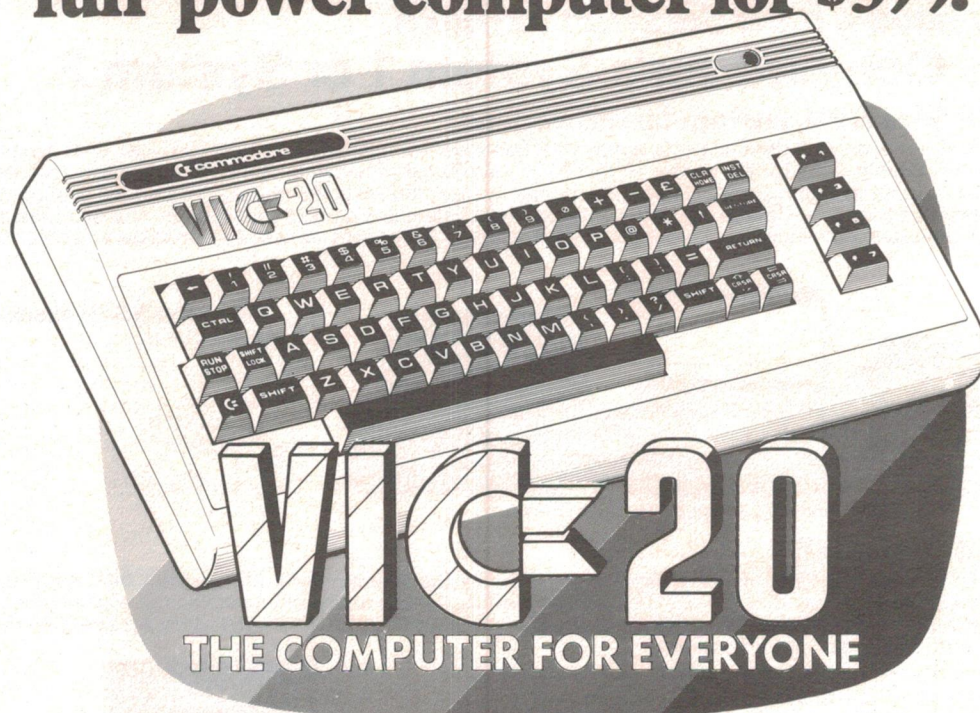
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# 660 SOFTWARE

## CATCH '660

First up this month we have another colour program. This one is from David Button of Sassafras in Victoria. The program is called 'Catch '660' because the object is not to get caught! Blocks appearing on the screen can 'catch' your 'man'. So watch it! The object of the game is to remain free as long as possible. Running into blocks on the edge of the screen ends the game. At the end your score will be displayed. Here's how to get it going:

First load the colour routines as per Programming the '660 in Colour, page 88 of the April '82 issue of ETI. Background colour may be changed by adding or deleting calls to 07A2 (these calls may be located at 0600, 0602 and 0604 — the first three lines of the program). Foreground colours may be changed by changing VD (variable D) at 0606.

To move your man, the following keys provide motion as follows:

KEY 1 = UP

KEY 9 = DOWN

KEY 6 = LEFT

KEY 4 = RIGHT

When the game ends, just press any key to start a new game.

Note that when you've loaded the program and debugged it, after pressing 8 to run the game, it takes a few seconds for the display to appear. Patience, people . . . patience.

```

0600 00FF  NOP
      07A2  GOSUB MLS
      00FF  NOP
      07C1  GOSUB MLS
      6D02  VD=COLOUR
      6E00  VE=00
      6F00  VF=00
      27AB  DO 07AB
0610 7E01  VE=VE+1
      3E08  SKF VE=08
      160E  GOTO 060E
      6E00  VE=00
      7F01  VF=VF+01
      3F18  SKF VF=18
      160E  GOTO 060E
      00FF  NOP
0620 6100  V1=00
      6201  V2=01
      A656  SET I
      D121  DXYN
      7108  V1=V1+08
      3140  SKF V1=40
      1626  GOTO 0626
      6100  V1=00
0630 622C  V2=2C
      D121  DXYN
      7108  V1=V1+08
      3140  SKF V1=40
      1632  GOTO 0632
      6100  V1=00
      6200  V2=00
      A657  SET I
  
```

```

0640 D121  DXYN
      7201  V2=V2+01
      322E  SKF V2=2E
      1640  GOTO 0640
      613F  V1=3F
      6200  V2=00
      D121  DXYN
      7201  V2=V2+01
0650 322E  SKF V2=2E
      164C  GOTO 064C
      1660  GOTO 0660
      FF80
      40E0
      40E0
      E0E0
      00FF  NOP
0660 6800  V8=00
      6A1E  VA=1E
      6B18  VB=18
      A658  SET I
      DAB3  DXYN
      A658  SET I
      FCOA  WAIT KEY
      7801  V8=V8+01
0670 3C01  SKF VC=01
      1680  GOTO 0680
      DAB3  DXYN
      6F00  VF=00
      7BFC  VB=VB+FC
      DAB3  DXYN
      4F01  SKF VF#01
      170C  GOTO 070C
0680 3C09  SKF VC=09
      1690  GOTO 0690
      DAB3  DXYN
      6F00  VF=00
      7B04  VB=VB+04
      DAB3  DXYN
      4F01  SKF VF#01
      170C  GOTO 170C
0690 3C04  SKF VC=04
      16A0  GOTO 06A0
      DAB3  DXYN
      6F00  VF=00
      7AFC  VA=VA+FC
      DAB3  DXYN
      4F01  SKF VF#01
      170C  GOTO 070C
06A0 3C06  SKF VC=06
      1734  GOTO 0734
      DAB3  DXYN
      6F00  VF=00
      7A04  VA=VA+04
      DAB3  DXYN
      4F01  SKF VF#01
      170C  GOTO 070C
06B0 16B8  GOTO 06B8
      78FF  V8=V8+FF
      166C  GOTO066C
      00FF  NOP
      6F00  VF=00
      6403  V4=03
      C50F  CXKK
      8455  V4-V5
  
```

```

06C0 3F01  VF SET ?
      16B8  GOTO 06B8
      00FF  NOP
      A65B  SET I
      86A0  V6=VA
      87B0  V7=VB
      3500  SKF V5=00
      16DA  GOTO 06DA
06D0 6F00  VF=00
      7604  V6=V6+04
      D673  DXYN
      4F01  SKF VF#01
      1706  GOTO 0706
      3501  SKF V5=01
      16E8  GOTO 06E8
      6F00  VF=00
06E0 76FC  V6=V6+FC
      D673  DXYN
      4F01  SKF VF#01
      1706  GOTO 0706
      3502  SKF V5=02
      16F6  GOTO 06F6
      6F00  VF=00
      7704  V7=V7+04
06F0 D673  DXYN
      4F01  SKF VF#01
      1706  GOTO 0706
      3503  SKF V5=03
      166A  GOTO 066A
      6F00  VF=00
      77FC  V7=V7+FC
      D673  DXYN
      4F01  SKF VF#01
0700 1706  GOTO 0706
      166A  GOTO 066A
      D673  DXYN
      16B8  GOTO 06B8
      00FF  NOP
      00E0  CLEAR SCREEN
      A730  SET I 0730
0710 F833  CONV V8 DEC
      F265  TRF DATA
      6318  V3=18
      6410  V4=10
      F029  FETCH
      D345  DXYN
      7306  SHIFT
      F129  FETCH
0720 D345  DXYN
      7306  SHIFT
      F229  FETCH
      D345  DXYN
      F60A  WAIT KEY
      00E0  CLEAR SCREEN
      1620  GOTO 0620
072E
0730 SCRATCHPAD
0732
      4C01  SKF VC#01
      16B8  GOTO 06B8
      4C09  SKF VC#09
      16B8  GOTO 06B8
      4C04  SKF VC#04
      16B8  GOTO 06B8
0740 16B2  GOTO 06B2
  
```





## HOW THE 'COLOUR PATTERNMAKER' WORKS

As promised last month in this column, here is a complete annotated listing of the Colour Patternmaker by Noel Plummer. Now if this doesn't generate a few ideas... If it does, we'd like to hear about them (and don't forget — we pay!).

### MAINLINE

```

0700 00FF  NOP
2 07C1  Call enable colour
4 6D06  VD = 06      (Pale Blue)
6 2738  Do colour 'SELECT ... GROUND'
8 2818  Do write 'BACK'
A 2800  Do write 'SELECT, GROUND'
C 2818  Do write 'BACK'
E 6D05  VD = 05      (Yellow)
10 2746  Do colour #'s
2 2818  Do write 'BACK'
4 2848  Do Display Background Colours
6 2754  Do Select Background Colour
8 00E0  Erase
A 00FF  NOP
  
```

PROMPT & SET  
BACKGROUND  
COLOUR

```

C 6D05  VD = 05      (Yellow)
E 2738  Do colour 'SELECT ... GROUND'
20 2820  Do write 'FORE'
2 2800  Do write 'SELECT, GROUND'
4 2820  Do write 'FORE'
6 6D06  VD = 06      (Pale Blue)
8 2746  Do colour #'s
A 2820  Do write 'FORE'
C 2878  Do Display Foreground Colours
E 2762  Do Select Foreground Colour(s)
30 00E0  Erase
2 6D00  VD = 00
4 1602  Go Kaleidoscope
6 00FF  NOP
  
```

PROMPT & SET  
FOREGROUND  
COLOUR(S)

### COLOUR 'SELECT ... GROUND'

```

0738 6900  V9 = 00      Y0
A 6A06  VA = 06      Xn
C 6B08  VB = 08      Yn
E 6E00  VE = 00      X0
40 2788  Do colour
2 00EE  Return
4 00FF  NOP
  
```

### COLOUR #'S

```

0746 690B  V9 = 0B      Y0
8 6A08  VA = 08      Xn
A 6B03  VB = 03      Yn
C 6E00  VE = 00      X0
E 2788  Do colour
50 00EE  Return
2 00FF  NOP
  
```

### SELECT BACKGROUND COLOUR

```

0754 F50A  Get Key
6 4500 loop SKP V5 ≠ 00
8 00EE  Return
A 75FF  V5 = V5-01
C 07A2  Call Step Background
E 1756  Go LOOP
60 00FF  NOP
  
```

### SELECT FOREGROUND COLOUR(S)

```

0762 6900  V9 = 00      Y0
4 6A08  VA = 08      Xn
6 6B10  VB = 10      Yn
8 FD0A  Get Key      Colour
A 6E00  VE = 00      X0
C 4D08  SKP VD ≠ 08
E 1774  Go two colours
70 2788  Do Colour
2 00EE  Return
4 FD0A  Two      Get Key      Colour (outer colour)
6 2788  Colours  Do Colour
8 6904  V9 = 04      Y0
A 6A04  VA = 04      Xn
C 6B08  VB = 08      Yn
E FD0A  Get Key      Colour (inner colour)
80 6E02  VE = 02      X0
2 2788  Do Colour
4 00EE  Return
6 00FF  NOP
  
```

### COLOUR

```

0788 88A0  V8 = VA      Xn (V8 = loop 2 Counter)
A 8CB0 loop 2 VC = VB      Yn (VC = loop 1 Counter)
C 8F90  VF = V9      Y0
E 27AB loop 1 Do Colour Routine
90 7CFF  VC = VC-1
2 7F01  VF = VF+1      next y
4 3C00  SKP VC = 00
6 178E  Go loop 1
8 78FF  V8 = V8-1
A 7E01  VE = VE+1      next x
C 3800  SKP V8 = 00
E 178A  Go loop 2
A0 00EE  Return
  
```

### 07A2 — 07FF ETI COLOUR ROUTINES

#### WRITE 'SELECT, GROUND'

```

0800 A8C0  I = 'SE'
2 6003  V0 = 03      X0
  
```



```

4 6103      V1 = 03      y
6 6303      V3 = 03      loop counter (prompt)
8 2838      Do Prompt
A 6013      V0 = 13      2nd line
C 610A      V1 = 0A
E 6303      V3 = 03      3 bytes
10 2838     Do Prompt
2 60EE      Return
4 00FF      NOP
6 00FF      NOP
    
```

## WRITE 'BACK'

```

0818 A8DE      I = 'BACK'
A 2828      Do write 'Back/Fore'
C 00EE      Return
E 00FF      NOP
    
```

## WRITE 'FORE'

```

0820 A8E8      I = 'FORE'
2 2828      Do Write 'Back/Fore'
4 00EE      Return
6 00FF      NOP
    
```

## WRITE 'BACK/FORE'

```

0828 6003      V0 = 03      X0
A 610A      V1 = 0A      y
C 6302      V3 = 02      2 bytes
E 2838      Do Prompt
30 00EE      Return
2 00FF      NOP
4 00FF      NOP
6 00FF      NOP
    
```

## PROMPT

```

0838 6705      V7 = 05      dl
A D015 loop    Shows @ V0, V1
C 7008      V0 = V0+08      next x
E F71E      I = I+ V7      next I
40 73FF      V3 = V3-1
2 3300      SKP V3 = 00
4 183A      Go loop
6 00EE      Return
    
```

## DISPLAY BACKGROUND COLOURS

```

0848 6007      V0 = 07      X0 (#'s)
A 6117      V1 = 17      y (#'s)
C 6210      V2 = 10      dX
E 6300      V3 = 00      #'s
50 6400      V4 = 00      XA0 (Show Colour)
2 6508      V5 = 08      XB0 (Show Colour)
4 6910      V9 = 10      Y0 (Colour)
6 6A02      VA = 02      Xn (Colour two bytes wide)
8 6B08      VB = 08      Yn (Colour)
A 6D02      VD = 02      blue
C 6E00      VE = 00      X0 (Colour)
E 2788      Do Colour
60 2898      Do Write #'s
2 6D00      VD = 00      black
4 2788      Do Colour
6 2898      Do Write #'s
8 6D04      VD = 04      green
A 2788      Do Colour
C 2898      Do Write #'s
E 6D01      VD = 01      red
70 2788      Do Colour
2 2898      Do Write #'s
4 00EE      Return
6 00FF      NOP
    
```

## DISPLAY FOREGROUND COLOURS

```

0878 6003      V0 = 03      X0 (#'s)
A 6117      V1 = 17      y (#'s)
C 6208      V2 = 08      dX
E 6300      V3 = 00      #'s
80 6400      V4 = 00      X0 (Show Colours)
2 6A01      VA = 01      Xn (Colour one byte wide)
4 6B08      VB = 08      Yn
6 6D00      VD = 00      first colour (black)
8 6910 loop    V9 = 10      Y0 (Colour)
A 8ED0      VE = VD      X = Colour
C 2788      Do Colour
E 7D01      VD = VD+01      next colour (and next X)
90 2898      Do write #'s      display # & reveal colour
2 3D08      SKP VD = 08      reached R.H.S. of screen?
4 1888      Go loop
6 00EE      Return
    
```

## WRITE #s

```

0898 F329      I = Dsp, V3
A D015      Show 5 @ V0, V1
C 28A8      Do Show Colours
E 8024      V0 = V0+V2      Next X (#'s)
A0 7301      V3 = V3+01      next #
2 00EE      Return
4 00FF      NOP
6 00FF      NOP
    
```

## SHOW COLOURS

```

08A8 661F      V6 = 1F      Y0-1
A 7601      V6 = V6+01 loop next y
C A8F2      I = (FF)
E D461      Show 1 @ V4, V6 (A)
B0 3208      SKP V2 = 08      V2 = 08 for foreground colours
2 D561      Show 1 @ V5, V6 (B)
4 3637      SKP V6 = 37      reached bottom of screen?
6 18AA      Go loop
8 8424      V4 = V4+V2      next X(A)
A 7510      V5 = V5+10      next X(B)
C 00EE      Return
E 00FF      NOP
    
```

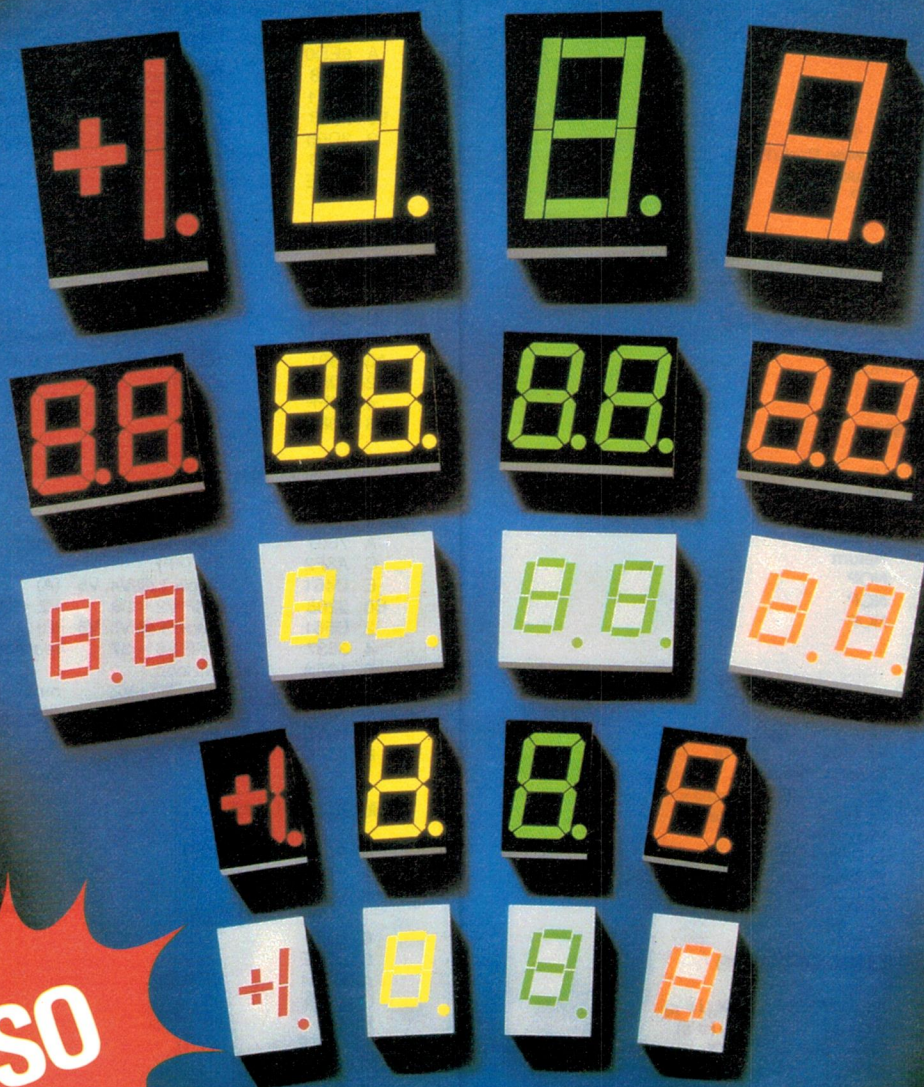
## CHARACTER DATA

```

08C0 EE88      (SE)
2 EE28
4 EE
8E (LE)
6 888E
8 88EE
A EE84      (CT)
C 8484
E E4
EE (GR)
D0 8A88
2 A8E8
4 EAAA      (OU)
6 AAAA
8 EE
EC (ND)
A AAAA
C AAAC
E EEAA      (BA)
E0 EEAA
2 EA
E8 (CK)
4 8A8C
6 8AEA
8 EE8A      (FO)
A EA8A
C 8E
EE (RE)
E A88E
F0 888E
2 FF
    
```



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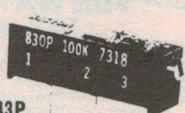
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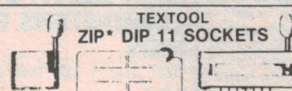
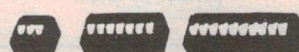
#### STOCK VALUES

10R, 20R, 50R, 100R, 200R, 500R, 1K,  
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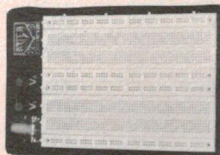




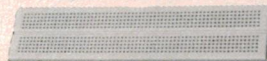
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# CHIP-8 COLUMN

In a routine written recently, six variables, V0-V5, were used. Now to use this routine with any program, great care needs to be taken not to have conflict between the calling program and the routine over possible joint use of the same variables.

How this is done is shown in an example involving not six but all sixteen variables. In this particular case the routine used information conveyed from the main program in the workhorse of CHIP-8, the V0 variable. How information can be conveyed back to the calling program is also shown.

CHIP-8 is a wonderful language for the computer hobbyist, having instructions which are easy to remember and use. The FX55 and FX65 are powerful instructions which may be a bit tricky at first, but the following should make them clear. In the instructions 6XKK and 8XY1 the X and Y represent a **variable**, but in FX55 and FX65 the X represents **the variables V0 to VX**, which could involve all variables if VX = VF. These instructions are a great moving combination when allied with the AMMM pointer.

Let's look at our example 1(a). On arrival at the subroutine a copy of all variables is stored, and just before return from the subroutine all variables are restored to their original values. The first instruction, AMMM, points to the start of memory locations set aside to store copy of variables. The number of locations required is indicated by the number of the variable used in the next instruction, FF55, which is F hexi-

decimal or 16 decimal. When FF55 is executed a **copy** of all 16 variables is put in locations 0MMM to 0MMM plus 15 decimal. Upon completion of the subroutine the reverse takes place and AMMM again points to the start of temporary store locations.

FF65 comes into the act and restores all variables by copying the contents of locations 0MMM to 0MMM + 15 decimal into the variables V0 to VF, just before returning to the program

which called the subroutine.

Should a result from the subroutine need to go back to the program it is only necessary to load variable V0 with information and store it using AMMM + X pointer, where X is the number of the variable to which the contents of V0 must be copied on return to the program, and AMMM again points to the first location of the temporary store. The routine then becomes as in 1(b).

FRANK REES

## SUBROUTINE

(a) Start Location: AMMM: Start of 16 locations.  
FF55: Store copy of V0 to VF there — your subroutine less '00EE'.  
↓  
AMMM: Same location again.  
FF65: Copy contents of location into V0 to VF.  
00EE: Return.

(b) Start Location: AMMM  
FF55  
↓  
AMMM + X, where X is number of variable.  
F055: Store copy of V0 from subroutine there.  
AMMM  
FF65  
00EE

**NOTE:** When speaking of CHIP-8 instructions, 0 to 9 and A to F are numbers. All other letters in instructions are arbitrary numbers.

## Try this 'program' for better understanding.

For 660 at 0600: A600  
FF65  
A480  
FF55  
0000  
1234  
5678  
9ABC

For VIP 0200: A200  
FF65  
A100  
FF55  
F000  
1234  
5678  
9ABC

Run 'program' and then inspect screen memory locations 0480 (or D100) onward; you have just block moved a copy of 'program' and data (1—C) to a new location.

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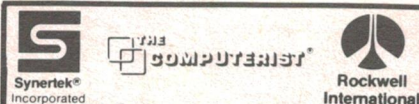
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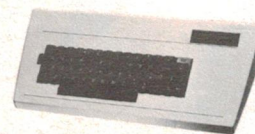
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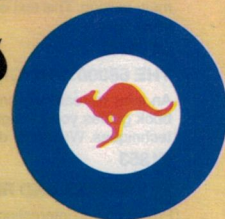
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Whereas ordinary detergent and water may only clean the surface, Glo-Wash removes stubborn road grime that would otherwise become ingrained and cause your paintwork to rapidly deteriorate.

And if you want to give your car extra special protection, The Kitten System brings you Wash-n-Wax. Wash-n-Wax is the blend of specially developed high quality cleaning agents and waxes that protects as it waxes your car's body.

But the beauty of both Wash-n-Wax and Glo-Wash is their wash-on/hose-off simplicity; there's no need to chamois anymore. And a good looking body won't cost you an arm and a leg: a bottle of Wash-n-Wax or Glo-Wash will wash the average car at least 17 times.

So for a good looking body, use Glo-Wash or Wash-n-Wax from The Kitten System at least once a week.



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2716	\$ 4.90	1771	\$18.00	74LS47	.85	2N301	2.20	2N5963	1.10	TIP33A	1.20	Ay-5-2376	19.56	74LS48	1.00	2N657	.60	TIP42B	1.50					
2732	\$ 8.00	1791	\$59.00	74LS49	1.00	2N930	.60	3N201	1.50	TIP42B	1.10	8748A	29.00	74LS51	.40	2N1613	1.10	TIP110	1.30					
6800	\$ 7.90	1795	\$59.00	74LS54	1.00	2N930	.60	3N201	1.50	TIP120	.90	8755A	45.00	74LS55	.55	2N1711	.50	TIP120	.90					
6802	\$11.00	4116	\$ 1.95	74LS55	.55	2N1893	1.00	AC127	1.00	TIP2955	1.90	MCT275	1.50	74LS58	.65	2N2219A	.60	TIP3055	1.90					
8809	\$19.00	2114	\$ 3.30	74LS73	.55			AD149	3.1C	VN88AF	3.90	MCT671	3.00	74LS74	.55			AD149	3.1C					
8085	\$ 9.00	AT7205	\$ 1.95	74LS74	.55	6N2222	.30	AD161	2.00	MM80C95	.90	4N28	.85	74LS75	.45	2N2463	.35	AD161	2.00					
8080	\$ 7.00	100 Red Leds	\$ 3.90	74LS76	.45	2N2463	.35	AD162	2.00	80C96	.90	4N28	.85	74LS77	.85	2N2484	.65	AD162	2.00					
6821	\$ 3.50	BUX80	\$ 1.90	74LS78	.50	2N2484	.65	BC318	3.90	80C96	.90	4N28	.85	74LS78	1.00	2N2646	1.10	BC318	3.90					
Z80P10	\$ 5.00	BU126	\$ 1.90	74LS83	1.00	2N2647	1.00	BC319	.18	80C96	.90	4N28	.85	74LS85	1.00	2N2894	.80	BC319	.18					
				74LS86	1.00	2N2904	.45	BC327	.15	80C96	.90	4N28	.85	74LS86	1.00	2N2904	.45	BC327	.15					
				74LS89	1.00	2N2904	.45	BC338	.30	80C96	.90	4N28	.85	74LS90	1.00	2N2904	.45	BC338	.30					
				74LS92	.90	2N2906	.45	BC547	.15	80C96	.90	4N28	.85	74LS92	.90	2N2906	.45	BC547	.15					
				74LS93	.80	2N2913	1.20	BC548	.15	80C96	.90	4N28	.85	74LS93	.80	2N2913	1.20	BC548	.15					
				74LS95	.65	2N3007	.60	BC549C	.15	80C96	.90	4N28	.85	74LS95	.65	2N3007	.60	BC549C	.15					
				74LS96	1.55	2N3053	.60	BC549C	.15	80C96	.90	4N28	.85	74LS96	1.55	2N3053	.60	BC549C	.15					
				74LS109	.60	2N3054	1.90	BC557	.16	80C96	.90	4N28	.85	74LS109	.60	2N3054	1.90	BC557	.16					
				74LS112	.60	2N3055	.90	BC558	.16	80C96	.90	4N28	.85	74LS112	.60	2N3055	.90	BC558	.16					
				74LS113	.65	2N3440	1.10	BC637	.60	80C96	.90	4N28	.85	74LS113	.65	2N3440	1.10	BC637	.60					
				74LS114	.50	2N3502	.70	BC638	.60	80C96	.90	4N28	.85	74LS114	.50	2N3502	.70	BC638	.60					
				74LS122	.50	2N3503	.70	BC639	.40	80C96	.90	4N28	.85	74LS122	.50	2N3503	.70	BC639	.40					
				74LS123	.75	2N3564	.30	BC640	.40	80C96	.90	4N28	.85	74LS123	.75	2N3564	.30	BC640	.40					
				74LS126	.70	2N3569	.30	BCY70	.85	80C96	.90	4N28	.85	74LS126	.70	2N3569	.30	BCY70	.85					
				74LS132	.80	PN3665	.30	BD115	1.50	80C96	.90	4N28	.85	74LS132	.80	PN3665	.30	BD115	1.50					
				74LS133	.50	PN3666	.30	BD135	.70	80C96	.90	4N28	.85	74LS133	.50	PN3666	.30	BD135	.70					
				74LS136	.50	PN3667	.30	BD136	.70	80C96	.90	4N28	.85	74LS136	.50	PN3667	.30	BD136	.70					
				74LS138	.80	PN3668	.30	BD137	.70	80C96	.90	4N28	.85	74LS138	.80	PN3668	.30	BD137	.70					
				74LS139	.85	PN3638	.30	BD138	.70	80C96	.90	4N28	.85	74LS139	.85	PN3638	.30	BD138	.70					
				74LS151	.75	PN3639	.30	BD139	.70	80C96	.90	4N28	.85	74LS151	.75	PN3639	.30	BD139	.70					
				74LS153	.60	PN3640	.30	BD140	.70	80C96	.90	4N28	.85	74LS153	.60	PN3640	.30	BD140	.70					
				74LS154	1.50	PN3641	.30	BD235	.65	80C96	.90	4N28	.85	74LS154	1.50	PN3641	.30	BD235	.65					
				74LS155	1.00	PN3645	.30	BD234	.50	80C96	.90	4N28	.85	74LS155	1.00	PN3645	.30	BD234	.50					
				74LS156	1.00	PN3642	.30	BD237	.50	80C96	.90	4N28	.85	74LS156	1.00	PN3642	.30	BD237	.50					
				74LS157	.90	PN3643	.30	BD262	1.20	80C96	.90	4N28	.85	74LS157	.90	PN3643	.30	BD262	1.20					
				74LS158	.70	PN3644	.30	BD301	.75	80C96	.90	4N28	.85	74LS158	.70	PN3644	.30	BD301	.75					
				74LS160	.85	PN3646	.30	BD302	.75	80C96	.90	4N28	.85	74LS160	.85	PN3646	.30	BD302	.75					
				74LS161	.85	PN3692	.50	BD263	1.25	80C96	.90	4N28	.85	74LS161	.85	PN3692	.50	BD263	1.25					
				74LS162	1.00	PN3693	.35	BD435	.75	80C96	.90	4N28	.85	74LS162	1.00	PN3693	.35	BD435	.75					
				74LS163	.85	PN3702	.30	BD646	1.70	80C96	.90	4N28	.85	74LS163	.85	PN3702	.30	BD646	1.70					
				74LS164	1.30	PN3694	.30	BD647	1.80	80C96	.90	4N28	.85	74LS164	1.30	PN3694	.30	BD647	1.80					
				74LS165	.50	PN3704	.30	BD675	.80	80C96	.90	4N28	.85	74LS165	.50	PN3704	.30	BD675	.80					
				74LS168	1.90	PN3709	.30	BDV648	4.50	80C96	.90	4N28	.85	74LS168	1.90	PN3709	.30	BDV648	4.50					
				74LS169	1.90	PN3713	2.20	BDV658	4.50	80C96	.90	4N28	.85	74LS169	1.90	PN3713	2.20	BDV658	4.50					
				74LS170	2.80	PN3819	.80	BF115	.50	80C96	.90	4N28	.85	74LS170	2.80	PN3819	.80	BF115	.50					
				74LS173	.90	PN3866	2.00	BF173	.70	80C96	.90	4N28	.85	74LS173	.90	PN3866	2.00	BF173	.70					
				74LS174	.90	PN3904	.30	BF180	.70	80C96	.90	4N28	.85	74LS174	.90	PN3904	.30	BF180	.70					
				74LS175	.90	PN3906	.30	BF195	.30	80C96	.90	4N28	.85	74LS175	.90	PN3906	.30	BF195	.30					
				74LS181	2.50	PN4030	1.10	BF198	.30	80C96	.90	4N28	.85	74LS181	2.50	PN4030	1.10	BF198	.30					
				74LS189	3.80	PN4032	.90	BF199	.30	80C96	.90	4N28	.85	74LS189	3.80	PN4032	.90	BF199	.30					
				74LS190	1.30	PN4033	.90	BF336	.80	80C96	.90	4N28	.85	74LS190	1.30	PN4033	.90	BF336	.80					
				74LS191	1.10	PN4036	1.00	BF337	.80	80C96	.90	4N28	.85	74LS191	1.10	PN4036	1.00	BF337	.80					
				74LS192	.85	PN4037	.90	BF458	.70	80C96	.90	4N28	.85	74LS192	.85	PN4037	.90	BF458	.70					
				74LS193	.85	PN4121	.30	BF494	.70	80C96	.90	4N28	.85	74LS193	.85	PN4121	.30	BF494	.70					
				74LS194	.70	PN4233	1.60	BF585	.75	80C96	.90	4N28	.85	74LS194	.70	PN4233	1.60	BF585	.75					
				74LS195	.90	PN4235	1.90	BFY50	.90	80C96	.90	4N28	.85	74LS195	.90	PN4235	1.90	BFY50	.90					
				74LS196	1.25	PN4236	2.20	BFY90	1.30	80C96	.90	4N28	.85	74LS196	1.25	PN4236	2.20	BFY90	1.30					
				74LS197	1.00	PN4248	.30	BSV17	3.00	80C96	.90	4N28	.85	74LS197	1.00	PN4248	.30	BSV17	3.00					
				74LS221	2.10	PN4249	.30	BU126	3.00	80C96	.90	4N28	.85	74LS221	2.10	PN4249	.30	BU126	3.00					
				74LS245	2.35	PN4250	.30	BU208	3.00	80C96	.90	4N28	.85	74LS245	2.35	PN4250	.30	BU208	3.00					



# minitool

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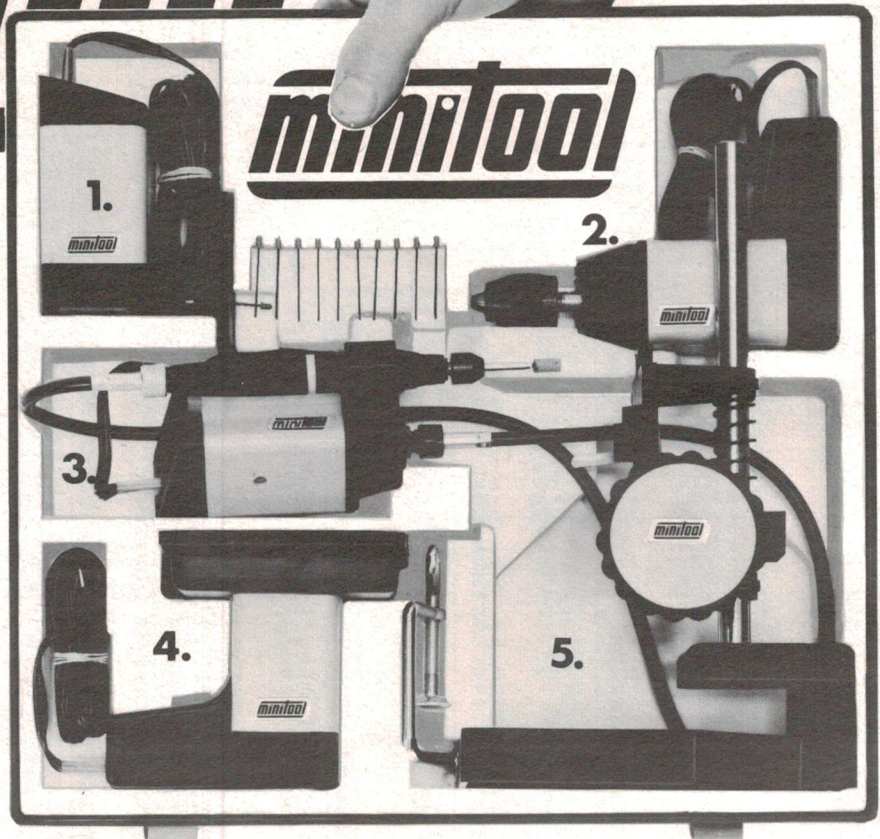
000.62.90X - Carry case, Power supply, Pistol drill, Drill stand, Orbital sander, Jigsaw, flexible Shaft unit, spare Blades, Table clamp, Platform table. R.R.P.

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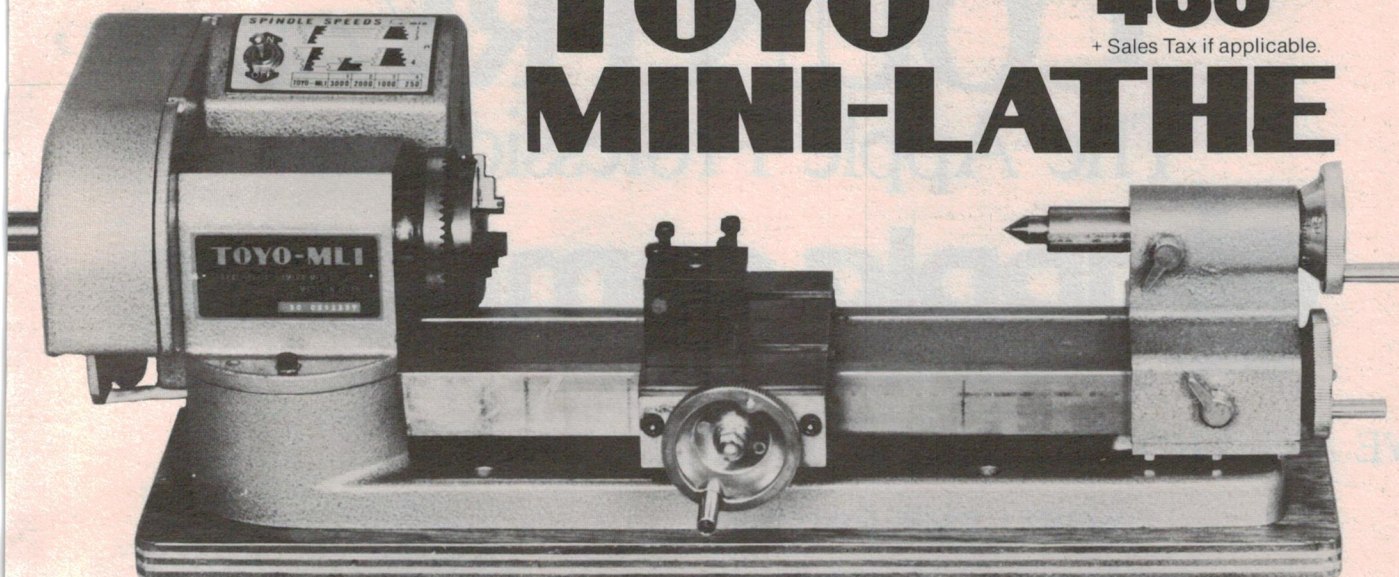




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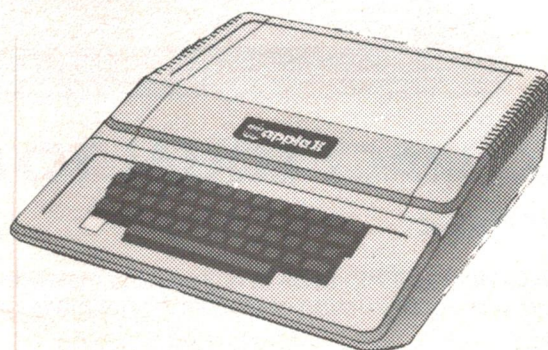
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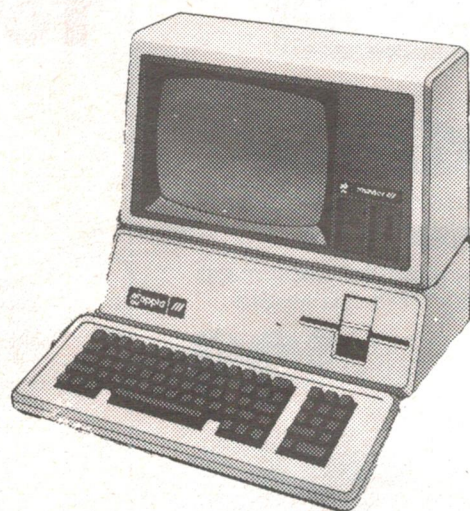
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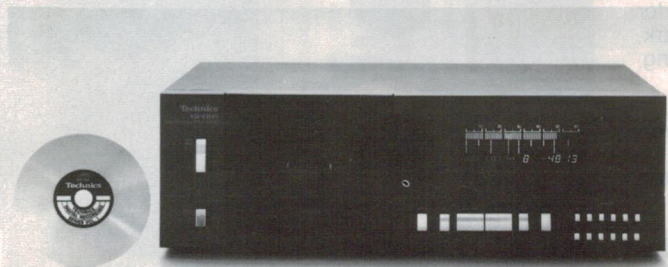


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# ELECTRONIC LIFESTYLE

## Technics introduce Compact Disc digital player



Matsushita Electric Industrial Co Ltd of Osaka, Japan has announced that it will introduce and demonstrate its first Compact Disc digital audio player, SQ-CD10.

The Technics SQ-CD10 features automatic disc loading from the front, as in most cassette decks. The unit can be connected to the 'aux' inputs of any preamplifier or integrated amplifier and requires no system alterations whatsoever. The unit is 430 mm wide, the same as all regular-size Technics amplifiers.

The unit features an optical pickup system using a semiconductor laser to ensure high reliability and long service life, Technics say. It also has automatic disc loading, play, stop/clear, fast forward, reverse, pause and repeat functions from a microcomputer governed full-logic electronic control. A combination of FL bar display, digital display and keyboard facilities provide a variety

of programming and information readout. These include: pickup position indicator in one minute steps; band interval position indicator; program-in-play indicator; digital indication of band number; digital indication of elapsed playing time (min, sec); programming of up to 41 locations in any sequence; random access to any band number and its elapsed playing time and skip play to the next program.

The CD (Compact Disc) format has a very strong possibility of becoming the accepted worldwide standard, Technics claim.

Being an exclusive audio medium, a CD with 60 minutes of playing time per side is only 12 cm in diameter, saving the record collector a great deal of space. As new LSI's are being developed, the disc player will also be made in very compact size, say Technics.

As there is no mechanical contact in playback, disc service life is theoretically unlimited. Absence of mechanical wear is also claimed to

greatly extend the service life of the optical pickup system.

Quick random access is possible. As an address code can be included in the signal format, it is possible, through keyboard operation, to gain instant access to any selection or song number, and any time slot. It is also technically possible to include visual information such as lyrics or performer's names for display on the player or on a CRT.

Technics give the following specifications for the SQ-CD10: disc playing time, per side — approx. 60 minutes; disc scanning velocity — 1.2-1.4 m/s; disc track pitch — 1.6  $\mu$ m; disc diameter — 120 mm; disc thickness — 1.2 mm; player frequency response — 20 Hz to 20 kHz; quantization — 16 bits/channel; signal-to-noise, dynamic range and channel separation — all better than 90 dB; harmonic distortion — less than 0.05%.

No date has been set for the unit's release in Australia.

### 'Go-anywhere' video from Sanyo

Sanyo's new portable video system comprises a recording deck, tuner-timer unit, ac power adaptor and a fully remote-controlled colour video camera. An optional carry-case is available for the portable recorder.

As with all Beta format video systems, the smaller size of the tape cassette has enabled Sanyo's engineers to develop an extremely compact design.

A unique feature of the system is said to be Sanyo's VSC 5800 colour camera with full remote facility. All controls are located on the side of the camera, within easy reach for fast action. All the tape deck's functions can be controlled from the camera itself — no need to take your hands off the camera at any time during recording!

The camera's reverse and forward search controls let you view the programme while the tape is re-

wound or advanced to the desired position. The 'play' button on the camera can be used for viewing a recorded tape through the viewfinder.

Other features of the system's camera include hue control, a removeable eyepiece for direct viewing, CRT viewfinder for bright, well defined focusing, microphone jack, remote control terminal and an earphone jack. A condenser microphone with a four-position telescopic boom is designed to minimise camera noise.

A colour check switch is used when adjusting the white balance, and an automatic iris adjustment

ensures professional picture quality. The camera also has a macro function for filming small objects at close range, and there is a choice of power or manual zoom.

VCT 5800P is available now from selected video specialists, department stores and electrical retailers throughout Australia at around

\$2250 including tuner. A range of handy accessories such as a camera case at \$59 and camera extension leads at \$35 is also available.

For further information contact Sanyo Australia Pty Ltd, 225 Miller Street, North Sydney NSW 2060. (02)436-1122.

### Electronic Lifestyle?

**Whatever happened to Sight & Sound? Its concept has been expanded — that's what!**

This section of the magazine was originally 'Sound' section. When video came along, we changed the section's name to 'Sight and Sound'. What with the increasing range, variety and styles of electronic entertainment equipment appearing and making its presence felt in almost every aspect of our daily lives, this section of the magazine seemed due for an update. Hence, Electronic Lifestyle.

What will we cover? Predominantly home electronic entertainment equipment, plus anything else that seems relevant. The emphasis will still be on audio and video though, as this sort of equipment has the greatest impact in the home and the widest interest among readers.



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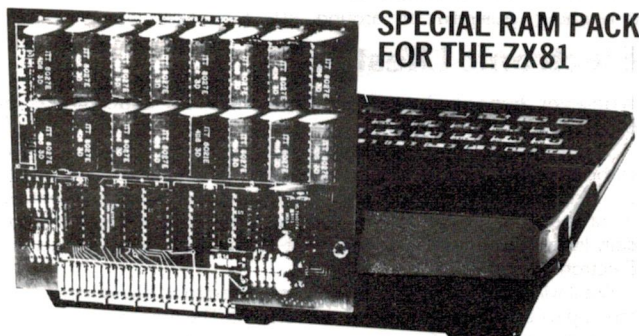
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**Barunda**  
G. Mills Stereo Ph: (07) 391 5606  
**Redcliff**  
Hi-Fi Sales Ph: (07) 284 2495

## 32K BYTES FOR THE ZX81



**SPECIAL RAM PACK  
FOR THE ZX81**

**PRICE FOR 32K RAM PACK (RP32)  
ONLY: \$165.00 incl. p&p (Australia)**

This board uses Dynamic RAM chips for lower cost and lower power consumption.

Simply plugs into the ZX81 expansion port offering 32K bytes for Basic programs and data handling. No extra PSU required. AMAZING!!!

Extra memory to help you build up your ZX81 into a powerful microprocessor system at an affordable price. Compare the price with other RAM PACKS available on the market!!!

### SEND ORDER TO:

VENDALE PTY. LTD., Dept. T7, P.O. Box 456, Glen Waverley,  
VICTORIA 3150.  
36 Plymouth St.,  
Glen Waverley  
(03) 232 0444.

**VENDALE**

VEN 0057



# Exclusive to Marantz. Very sophisticated. Very superior. Very expensive.



Very high fi indeed.

These Marantz Gold components represent the world's most advanced, most inspired, most stringently tested and sophisticatedly engineered audio equipment.

For the wealthy—exclusive toys.

For the connoisseur—the finest hi-fi money can buy.

The Marantz TT1000 (around \$2500), with its precision-made high density glass and golden aluminium sandwich structure, is justifiably described as one of the most beautiful turntables ever.

'Playing a series of direct-recorded discs, warped discs, discs with nasty low frequency content and discs requiring unusual trackability performance, showed clearly that this system borders on the superlative in areas where even most good turntables only provide good to above average performance.'

'...the resonance characteristics of the TT1000 are the lowest we have yet seen from any turntable irrespective of its selling price.'

'This is top-of-the-line equipment for people who rate hi-fi as their greatest pleasure in life'.

— Louis Challis, *Electronics Today International*, April 1981.

Similarly, the Marantz SM1000 Stereo Amplifier (around \$5000) is designed to be the ultimate in luxury and performance.

When it was bench-tested by ETI Magazine in an exhaustive lab study, Louis Challis stated 'The Marantz SM1000 Amplifier has the capability to provide superlative performance at home, in a laboratory, in a studio, or in a rock band with the ease and panache of a professional.'

'The power output claims are modest for the unit is readily capable of producing 625 watts into an 8 ohm load with both channels driven...'

And when the Marantz ST8 FM/AM Tuner (around \$700) was

put through its paces so technically surprising was its performance that a second series of tests was devised to check the first results.

'As a result... the Marantz ST8... far ahead of any tuner we have ever measured and better than any tuner we have ever seen reviewed in any other

magazine, either local or overseas.' — Paul de Noskowski, *Electronics Australia*, April 1981.



The TT1000's adjustable, high-absorption air suspension audio insulator feet.

**Marantz Gold.**  
**The New Audio Standard.**



Detailed specifications of these exclusive Marantz Gold components are available on request by writing to:

Marantz (Australia) Pty. Limited,  
19 Chard Road, Brookvale, NSW 2100  
Phone (02) 939 1900 Telex AA24121  
Melbourne (03) 544 2011  
Brisbane (07) 44 6477  
Adelaide (08) 223 2699  
Perth (09) 276 3706  
Townsville (077) 72 2011

**marantz®**





# MODEL: ANDROMEDA II



## GENERAL DESCRIPTION:

The Andromeda II is a development of five years work, over a painstaking process of elimination, to come up with something this good. All the components are heavily modified and have been changed to suit our design. The reflex twin load porting which is also damped, is at 50Hz to maximise the rear wave in phase to the front, and remain tight also. The use of two midranges is to gain the best in vocal and solo instrument display pattern. The attenuators are constant impedance, the H.F. radiator also modified. One of our "top of the range."

## CABINET MATCHING:

1,000mm de luxe only veneer.

SOUND PRESSURE LEVEL: 1 watt, 1 meter.

94db.

SHIPPING: 1 speaker per carton (matched pairs).

WEIGHT	IN CARTON	OUT OF CARTON
	37.5 Kg.	36 Kg.

## DIMENSIONS:

Height	1070 mm	1000 mm
Width	460mm	390mm
Depth	480mm	430mm

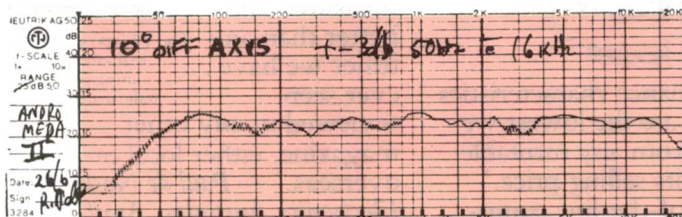
## SPECIFICATIONS:

TYPE: 30cm (12") tuned twin reflex  
SYSTEM: 30cm (12") 3-way, 4-element  
MAXIMUM RATING: 150 watts (8 ohm)  
MINIMUM PREF. DRIVE: 30 watts (8 ohm)  
DRIVER SIZE: 30cm (12")  
CAPACITY: 108 litres  
BAFFLE: 26mm heavy braced  
COLOURS AVAIL.: Sen Ash Oak Veneer  
ATTENUATION: Mid and high constant  
CROSSOVER TYPE: Inductive-cap-res.  
CROSSOVER frequ: 360 Hz-5kHz  
MIDRANGE ROLLDOWN: 6db.  
MIDRANGE ROLLOFF: 6db.  
DRIVER ROLLOFF: 6db.  
TWEETER ROLLDOWN: 18db.  
TWEETER ROLLOFF: N/A  
SUPERTWEETER ROLLDOWN: N/A  
FREQUENCY RANGE: 20 Hz to 20 kHz  
EFFECTIVE RANGE: 35 Hz to 20 kHz

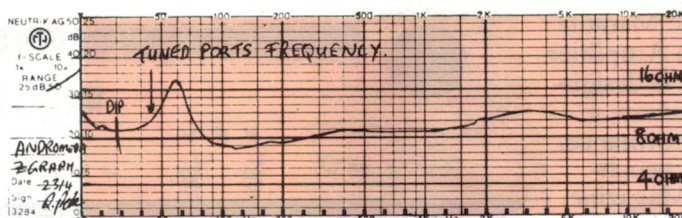
ALL GRAPHS ARE LIVE ENVIRONMENTAL

ALL S.P.L. LEVELS ARE CALCULATED FROM A PINK NOISE SOURCE. 1 WATT, 1 METER.

(THIS IS, WE FEEL, A MORE ACCURATE INDICATION OF MUSICAL LISTENING LEVELS, THAN RANDOM SPOT FREQUENCY METHODS).



FREQUENCY GRAPH: CALIBRATED. 0 - 50 db Scale



IMPEDANCE GRAPH (Z) CALIBRATED. 0 - 25 db Scale



# PETERSON SPEAKER LABORATORIES P/L

**VICTORIA:** Clive Peeters, all stores; Frankston Sound, Frankston; Brash's, all stores; Reliance Hi-Fi, Footscray; Gleeson & Tonta, Dandenong; Col McKinnon, Sunbury; Crosbies Hi-Fi, Northcote. **COUNTRY:** Mildura Audio World, Mildura; Maryvale Electronics, Morwell & Moe; John Thomas, Ballarat; Roy Vincents, Echuca; Sounds Alive, Shepparton; Peter Huthnance Audio, Bendigo; Brystan, Ryrie St. Geelong. **NEW SOUTH WALES:** Orange Audio, Orange; Car Radio & Hi-Fi, Wagga Wagga; The Record Centre, Griffith; Brian Bambach Electronics, Newcastle; Nitronics, Coffs Harbour; Kent Hi-Fi, Sydney. **WESTERN AUSTRALIA:** High Fidelity Stereo, Picadilly Sq. Perth. **QUEENSLAND:** Queensland Entertainment Co., Eight Mile Plains; Downtown Hi-Fi, Charlotte St. Brisbane. **SOUTH AUSTRALIA:** Audio World, Rundle St. Adelaide; Ernsmiths, The Parade Norwood; Astra Hi-Fi, Woodville Sth. **SOUTH AUSTRALIA (COUNTRY):** O'Connells Stores.



# LIFESTYLE NEWS



## Technics' SP-10Mk3 turntable breaks records!

Featuring a record-breaking wow and flutter figure of 0.015%, Technics' new quartz synthesiser direct-drive turntable, the SP-10Mk3 is slated to set new standards in turntable performance, according to Technics.

Its predecessor, the SP-10Mk2 has gained a worldwide reputation for quality and performance — so much so that the Australian Broad-

casting Commission's tender specification for turntables says "Technics SP-10 or equivalent".

The SP-10Mk3 incorporates an

integral-platter rotor direct-drive motor with a start-up torque quoted as 16 kg.cm which can bring the massive 10 kg platter up to rated 33½ RPM speed in quarter of a second! To translate this performance, Technics say that, in theory, as many as 1000 arms, each with 2 g tracking force, could trace a record on this turntable without slowing down the platter at all! A combination of electrical and mechanical braking is incorporated to bring the platter to a stop from 33½ RPM within 0.4 second.

The platter, a two layer structure of diecast aluminium and a copper alloy, weighs 10 kg and provides a moment of inertia of 1.1 ton.cm. The turntable body is made of zinc diecast and aluminium diecast and supported on a lower base of anti-resonant compound guarding it effectively against floor-borne and air-borne acoustic feedback.

The quartz oscillator, phase

locked servo system reduces wow & flutter to 0.015% WRMS and keeps speed deviation within 0.001%. Rumble is extremely low, the S/N ratio measuring at 92 dB (DIN B, weighted).

One of the few turntables equipped with 78 rpm speed in addition to the standard 33 and 45 rpm, the SP-10Mk3 also offers pitch control in 0.1% increments.

The turntable cannot only be 'fine-tuned' to fit the pitch of musical instruments, but playing times can be precision adjusted to fit available time slots in broadcasting.

The power supply and all controls are located in a separate, cable-connected unit. Remote control is also possible. The unit's dimensions are practically identical with those of the SP-10Mk2, making replacement easy.

It should be available in Australia late this year or early next year.

## New Dynavector arm

Concept Audio, importers and distributors in Australia for Dynavector Products, have released a new Dynavector tone arm designated the DV-501.

This new tone arm has similar features to its now well-established and famous big brother, the DV-505, inasmuch as it is a biaxis inertia controlled structure with an electromagnetic damping system. In addition to this, the new DV-501 has an arm lifting device built-in.

Of special interest to Rega turntable enthusiasts, Concept Audio are pleased to announce that the new DV-501 will fit on a Rega turn-

table with the lid closed, which was previously not possible with the DV-505.

At \$450 recommended retail price, the new Dynavector tone arm is expected to gain popularity in the audiophile marketplace very quickly, Concept say. More details from Concept Audio, 22 Wattle Rd, Brookvale NSW 2100. (02) 938-3700.

## Support your records

**Impedance matching a record to a turntable seems an unlikely idea, but the TriPad from Monster Cable claims to do just that.**

The TriPad is constructed of three layers of vastly differing materials, each designed to combat a different problem, they say.

The top surface is an aggregate of cork and rubber particles claimed to damp vinyl resonances. A soft centre area under the record label isolates and damps vibrations arising in the spindle, according to the manufacturers.

The bottom surface is the same soft material used in the top label area, said to damp microvibrations from the turntable platter.

The core of the mat is claimed to isolate the upper and lower surfaces, isolating the conflicting set of vibrations. The top surface is contoured to match the tapered shape of the record. The mat has a low mass, preventing undue extra stress on the turntable.

The makers claim the sonic improvement when using the mat has to be heard to be believed. Enquiries to Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088.



## POWERLINE — FROM MONSTER CABLE

Monster Cable, makers of the well-known speaker cable of the same name, have come up with what they claim is a new 'high definition' speaker cable, called 'Powerline'. It's a four-conductor, 'controlled impedance' cable using two cables per line in a special cross-coupled configuration. The cable exhibits extremely low resistance and is claimed to provide maximum power transfer and negligible phase-shift and high frequency attenuation. Distributed by Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088.



# Why Technics Space Dimension

Leave the walls where they are. Why do so many users of good quality sound equipment wish to change or modify their listening environment?

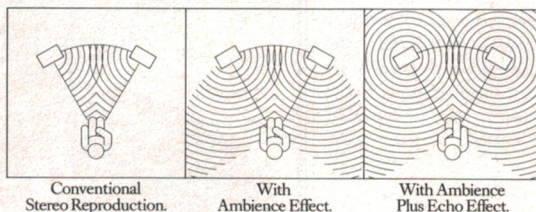
Because no matter how good a stereo set-up may be, it will always lack a vital ingredient of a live performance – the ambience and echo characteristic of a concert hall – the third dimension of sound.

Now Technics can provide an interesting answer.

Let Technics process the signal. To add this extra dimension to sound reproduction, Technics have developed a special signal processing device – the Space Dimension Controller.

You may think the name sounds dramatic.

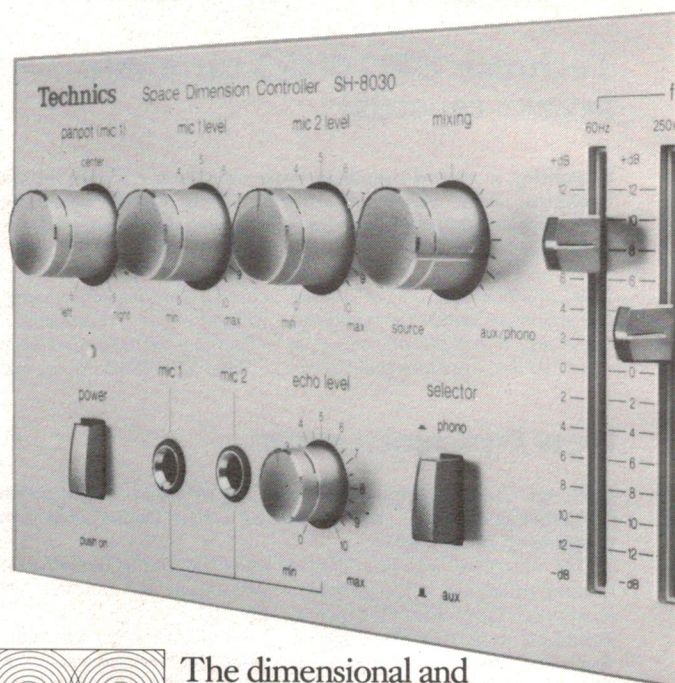
The effect this processing has on conventional stereo reproduction is more than dramatic.



It is stunning; a whole new listening experience.

**Surrounded by sound – from 2 speakers.** The Space Dimension Controller is based on the results of studies in psychoacoustics – or how the brain interprets sound.

Technics can now create a complex aural illusion, that you can control to suit your personal tastes.



The dimensional and echo facilities on this remarkable device add presence and impact to the sounds you hear.

They can completely alter your 'listening stage'.

From being limited to the space between your speakers, the Sound Dimension Controller expands the stereo image to a maximum of 240° – in other words, to 30° *behind you*.

And remember, this is still using only your original two speakers.

**Your own concert hall or recording studio.** Technics have included other useful



# developed Dimension Control.



additional facilities as well: A built-in graphic equalizer; a 'pan pot' (a device to relocate the aural position of anything recorded through the Mic 1 input); plus a program source mixer for fade effects using a second turntable.

However you choose to use the Space Dimension Controller, the end result will be a vastly more entertaining and exciting performance from your existing system.

Of course, all Technics components have a two-year warranty.

Ask your  
Technics dealer for a demonstration.  
Very soon.

**Technics**  
Expanding the music experience.

Dailey/NPA132



# GRAND HI-FI CONTEST!

*Here's an unbeatable opportunity  
to win some fabulous hi-fi gear*

We've assembled **over \$7000 worth** of 'top-shelf' equipment and accessories from some of the world's best-known audio equipment manufacturers to be presented as prizes in the Grand Hi-Fi Contest. We've equipment from Allsop, Audio-Technica, KEF, Marantz, Monster Cable, National Technic, Pioneer, Rega, Sansui, Sennheiser, SME, Sharp, Shure, and TDK.

**YOU COULD WIN A COMPLETE SYSTEM, PLUS ACCESSORIES,  
WORTH NEARLY \$5000! — that's some first prize!**  
**OR — YOU COULD WIN A COMPLETE PORTABLE SYSTEM AND  
ACCESSORIES WORTH MORE THAN \$1100!**  
**AND THERE ARE 12 CONSOLATION PRIZES! — ranging in value  
from about \$220 to about \$15. ALL IN OUR UNBEATABLE**

## \$7000 GRAND HI-FI CONTEST!

### JUST LOOK AT THE PRIZE LIST:

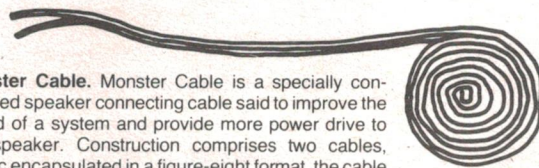
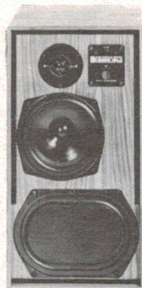
**Audio-Technica.** One **Audio-Technica ATH8 stereo headphones set.** This superb set of electret headphones — complete with adaptor — offers superb performance. Reviewing them in ETI, September '81, our audio consultant Louis Challis said these headphones "... offer a rare example of ... the sort of quality now regarded as the norm from the best loudspeakers." Value: \$353.50. Six **Audio-Technica AT125LC cartridges.** Audio-Technica's new 'para-toroidal' 100-series range of moving-magnet cartridges feature special toroidal-wound coils and dual magnets. AT claim this provides them with outstanding linearity, efficiency and frequency response. Value: \$65 each.

**KEF.** A pair of **KEF 104AB loudspeakers** are included in the first prize. KEF's constant research — in particular, their pioneering of the 'cumulative delay response' test technique — has earned them a deserved reputation as being amongst the world's top loudspeaker manufacturers. The KEF 104ABs have an almost unrivalled reputation for linearity and sound quality. Value: \$890.

**Allsop.** Twenty **Allsop 3, Model 70300 cassette deck cleaners.** These unique cleaners, housed in a cassette case, are driven by the cassette drive mechanism and clean the heads, capstan and pinch roller with non-abrasive felt pads. Value: \$8.50 each. Six **Allsop 3, Model 58000 Orbitrac record cleaning systems.** Another unique Allsop product; the soft bristles of the special cleaning pad, together with the special cleaning solution sprayed on the pad, remove dust and grit from the grooves. Cleaning is not done on the turntable, which can upset drive mechanisms. Value \$37.95 each.



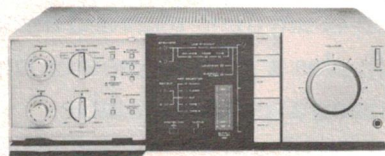
**Marantz.** Marantz have offered their superb **ST-8 FM/AM tuner.** This tuner features an oscilloscope tuning display, 'quartz-lock' tuning, low distortion detection and very high signal-to-noise ratio. On FM stereo, Marantz quote an 80 dB S/N ratio, 55 dB on AM. THD on FM stereo is quoted as 0.06% and frequency response as 30 Hz-15 kHz, +0.2, -1 dB. Value \$713.



**Monster Cable.** Monster Cable is a specially constructed speaker connecting cable said to improve the sound of a system and provide more power drive to the speaker. Construction comprises two cables, plastic encapsulated in a figure-eight format, the cable being many strands of fine copper wire. Value: \$3.58/metre (length to suit).



**National Technics.** One of their latest **microprocessor controlled, dbx cassette decks** is offered — **the RS-M255.** This is a three-head, two-motor machine with colour-coded fluorescent bargraph level display, soft touch controls and metal capability. It has both Dolby and dbx noise reduction systems. This deck is included in the first prize.



**Pioneer.** Pioneer have provided an **A8 amplifier.** Reviewed in ETI only last month, this 90 W/channel amp features extremely low distortion — with a THD of 0.0036% at 1 kHz — superb transient response and excellent signal-to-noise ratios. Louis Challis used words like 'superlative' and 'exemplary'. Value \$759.

**Rega.** The **Rega Planar 3 two-speed turntable** has been offered by Concept Audio. Noted for their superb engineering and simple design, Rega turntables have a deservedly good reputation among hi-fi buffs. Value: \$445. (This will be fitted with the SME arm and Shure cartridge mentioned later).

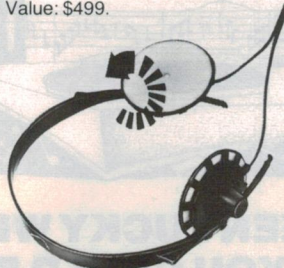






**Sansui.** Sansui have provided their **SE-8 stereo graphic equaliser/analyser**, featuring a 10-band equaliser in each channel and a plasma spectrum analyser display. In reviewing the SE-8 in ETI's December '81 issue, Louis Challis said the unit "... comes closer to the amateur's expectation of a panacea than anything else ... yet seen ...". Value: \$499.

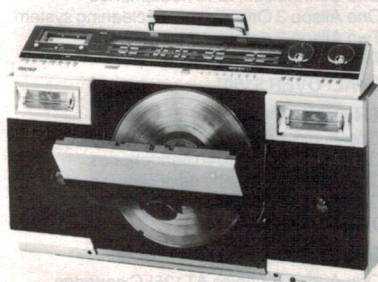
**Sennheiser.** Six **Sennheiser Model HD40 headphones**. These super-light headphones feature a frequency response of 22 Hz-18 kHz and the finest reproduction, the manufacturers say. They have nominal impedance of 600 ohms and are supplied with three metres of cable. Value \$29.75 each.



**SME.** Audio Engineers have provided an **SME tonearm** — to be fitted to the Rega turntable. Whenever tonearms are mentioned in conversation, SME is **always** mentioned. Their reputation is unrivalled. Value: \$280.



**Shure.** With the SME tonearm, Audio Engineers have thrown in the fabulous new **Shure moving magnet cartridge — the V15 Mk V**. This cartridge has received critical acclaim from reviewers all over the world. Its predecessor, the V15 Mk IV, virtually set a 'standard'; the Mk V looks like establishing a new standard. Value: \$375.



**Sharp.** The **Sharp VZ2000 portable hi-fi system** was only recently released here. It features a vertical, bilateral, linear tracking disc player that can **play both sides** of a record without having to turn it over! The system includes a cassette deck with Dolby noise reduction, metal tape capability and an 'auto program search system'. There's a stereo FM/AM tuner too, and the two-way loud-speaker system has separate amplifiers for the woofers and tweeters, providing a total 10 W/channel output. The VZ2000 can be powered from mains, internal batteries or 12 Vdc. Value: \$995.



**TDK.** 50 **TDK SA-C90 cassettes**. TDK tapes need no introduction. The SA on these cassettes stands for 'Super Avilyn', which is TDK's designation for TDK's cobalt-enriched ferric oxide formulation medium. SA tapes are used on high bias/eq setting on a cassette and offer better MOL and frequency response than top-ranked chrome tapes, according to TDK. Value: \$6.38 each.

## Prizes have been kindly donated by the following firms:

**Audio Engineers (SME, Shure)**  
342 Kent St, Sydney NSW 2000

**Pioneer Electronics (Australia)**  
178-184 Boundary Rd, Braeside Vic. 3195

**Concept Audio (Rega)**  
22 Wattle Rd, Brookvale NSW 2100

**R.H. Cunningham (Sennheiser)**  
146 Roden St, West Melbourne Vic. 3003

**Convoy International (Monster Cable)**  
4 Dowling St, Woolloomooloo NSW 2011

**Marantz Australia**  
19 Chard Rd, Brookvale NSW 2100

**National Panasonic (Aust.)**  
95-99 Epping Rd, North Ryde NSW 2113

**Vanfi Australia (Sansui)**  
198 Normanby Rd, South Melbourne Vic. 3205

**Maurice Chapman Aust. (Audio-Technica)**  
44 Dickson Ave, Artarmon NSW 2064

**Communication Power Inc. (Allsop)**  
P.O. Box 246, Double Bay NSW 2028

**TDK Australia**  
Unit 5, Level B South, 100 Harris St, Pyrmont NSW 2009

**Audioson (KEF)**  
64 Winbourne Rd, Brookvale NSW 2100

**Sharp Corporation of Australia**  
64-72 Seville St, Fairfield NSW 2165

**NOW TURN THE PAGE FOR YOUR  
CHANCE TO WIN THESE GREAT PRIZES!**



# GRAND HI-FI CONTEST!



**WE'RE LOOKING FOR FOURTEEN LUCKY WINNERS FOR THESE  
FOURTEEN SUPER PRIZES — YOU COULD BE AMONG THEM!**

## HOW TO ENTER

All you have to do is answer the questions on the entry form on the opposite page, fill out the coupon and send your entry to:  
**ETI, GRAND HI-FI CONTEST,  
15 Boundary St,  
Rushcutters Bay NSW 2011.**

Please read the rules **carefully**.

Multiple entries will be accepted. You must enter your name and address on each entry submitted. Photostats or clearly written copies of the entry form will be accepted, but if sending copies you **must** cut out and include with **each entry form** the month and page number from the bottom of the page of the contest. When sending multiple entries, then, you will need extra copies of the magazine so that you send an original page number with each entry.

**CONTEST CLOSES 31 AUGUST 1982**

## FIRST PRIZE

**Complete hi-fi system, comprising:**

- Shure V15 Mk V cartridge
- SME tonearm
- Rega Planar 3 turntable
- Allsop 3 Orbitrac record cleaner
- Technics RSM255 cassette deck
- 10 TDK SA-C90 cassette tapes
- Two Allsop 3 cassette deck cleaners
- Marantz ST8 FM/AM stereo tuner with oscilloscope
- Pioneer A8 stereo amplifier
- Sansui SE8 equaliser
- KEF 104AB loudspeakers
- Pair of speaker wires by Monster Cable
- Audio-Technica ATH8 headphone set

**TOTAL : OVER \$4900!**

## SECOND PRIZE

**Complete portable hi-fi system, comprising:**

- Sharp VZ2000 portable hi-fi system
- Two Allsop 3 cassette deck cleaners
- Allsop 3 Orbitrac record cleaning system
- 10 TDK SA-C90 cassette tapes
- Sennheiser model HD40 headphones

**TOTAL: OVER \$1100!**

## PLUS THESE SIX OTHER GREAT PRIZES!

### 1ST CONSOLATION

- One Audio-Technica AT125LC cartridge
- Two Sennheiser HD40 headphones
- Two Allsop 3 cassette deck cleaners
- One Allsop 3 Orbitrac record cleaning system
- Eight TDK SA-C90 cassette tapes

**TOTAL: OVER \$220!**

### 2ND CONSOLATION

- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 Orbitrac record cleaning system
- Two Allsop 3 cassette deck cleaners
- Six TDK SA-C90 cassette tapes

**TOTAL: OVER \$185!**

### 3RD CONSOLATION

- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 Orbitrac record cleaning system
- Two Allsop 3 cassette deck cleaners
- Four TDK C-90 cassette tapes

**TOTAL: OVER \$170!**

### 4TH CONSOLATION

- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 Orbitrac record cleaning system
- Two Allsop 3 cassette deck cleaners
- Two TDK SA-C90 cassette tapes

**TOTAL: OVER \$150!**

### 5TH CONSOLATION

- One Audio-Technica AT125LC cartridge
- One Sennheiser HD40 headphones
- One Allsop 3 cassette deck cleaner
- One TDK SA-C90 cassette tape

**TOTAL: OVER \$115!**

### 6TH CONSOLATION

- One Audio-Technica AT125LC cartridge
- One Allsop 3 cassette deck cleaner
- Two TDK SA-C90 cassette tapes

**TOTAL: OVER \$85!**

**PLUS — SIX RUNNERS-UP**, each receiving: • One Allsop 3 cassette deck cleaner worth \$8.50  
• One TDK SA-C90 cassette tape, worth \$6.38.

## RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Audio Engineers Pty Ltd, Pioneer Electronics (Australia) Pty Ltd, Concept Audio Pty Ltd, R.H. Cunningham Pty Ltd, Convoy International Pty Ltd, Marantz Australia Pty Ltd, National Panasonic (Aust.) Pty Ltd, Vanfi (Australia) Pty Ltd, Maurice Chapman Aust. Pty Ltd, Communications Power Inc. (Aust.) Pty Ltd, TDK (Australia) Pty Ltd, Audioson Pty Ltd, Sharp Corporation of Australia Pty Ltd, Murray Publishers, Offset Alpine, Australian Consolidated Press and/or associated companies.

**Closing date for the contest is 31 August 1982.**

Entries received within seven days of the closing date will be accepted if postmarked prior to and including 31 August 1982.

The winning entries will be drawn by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding that decision.

Following closing of the contest, all entries will be put into a box and thoroughly mixed. Entries will then be drawn from the box at random and the first fourteen correct entries drawn

will be declared winners in the order drawn.

Winners will be advised by telegram the same day the result is declared. The name of the winners, together with the winning answers, will be published in the next possible issue of ETI.

Contestants must enter their name and address where indicated on each entry form. Photostats or clearly written copies will be accepted, but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration, accompanying this contest, that they have read the above rules and agree to abide by their conditions.

**You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand portion of the page containing the entry form. You must put your name and address on the entry form and sign it where indicated.**



# ENTRY FORM

TC.82-801

## QUESTION 1

It can be established without any shadow of doubt that one and only one of the following statements is true. In each instance the statement relates to whether or not significant scientific discoveries were made in Britain between September 3rd and September 13th 1752.

- ☐ Many significant discoveries were made
- ☐ A few significant discoveries were made
- ☐ No significant discoveries were made
- ☐ The question is impossible to answer

## QUESTION 2

On February 14th 1876 Alexander Graham Bell filed his now-famous patent for a telephonic apparatus. Just three hours later (and hence three hours too late) someone filed a caveat with the Patent Office regarding a basically similar device. What was that person's surname?

- ☐ White
- ☐ Brown
- ☐ Gray
- ☐ Siemens
- ☐ Edison

## QUESTION 3

Who utilised a diaphragm and hog bristle to develop what? And (roughly) when?

Who? .....

What? ..... When? .....

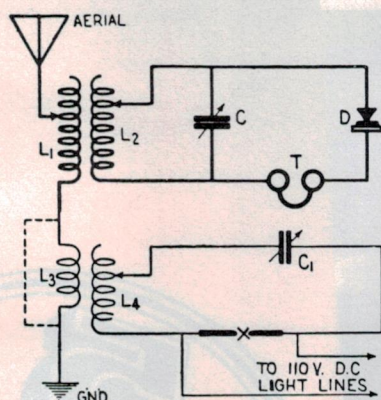
## QUESTION 4

What were the physical dimensions of Hollerith's first punched cards? What influenced him to use that specific size?

.....

.....

.....



## QUESTION 5

What is this device — please explain in less than 25 words. (note — the caption 110 V. D.C. is **not** an error)

.....

.....

## QUESTION 6

What is/was a 'Rheotome'?

- ☐ Early wave-form plotter
- ☐ Book of resistor terminology
- ☐ Type of rheostat
- ☐ Early 'Variac'
- ☐ Transformer with variable primary/secondary ratio

## QUESTION 7

Who wrote "Is it a fact — or have I dreamt it — that, by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point of time?"

Clue: the year was 1851.

- ☐ Nathaniel Hawthorne
- ☐ Neville Williams
- ☐ Joseph Joubert
- ☐ Charles Lamb
- ☐ William Hazlitt
- ☐ Dennis Lingane

## QUESTION 8

Decimal time was actually introduced by one European country and retained for two years.

Which country? .....

Approximately when? .....



## QUESTION 9

Who is this man (born 1806) and how did he have great influence on computing? Limit answer to 25 words maximum please.

.....

.....

## QUESTION 10

The discovery of thermoelectricity is usually attributed to T.J. Seebeck. There is evidence that his discovery was anticipated by someone else. Further to this, the effect was also discovered quite independently by yet another. Who were these two people? (Tick two names.)

- ☐ Peltier
- ☐ Cummings
- ☐ Dessaignes
- ☐ Nobili
- ☐ Faraday
- ☐ Melloni

## QUESTION 11

Taking facsimile transmission to mean 'a method by which printed, handwritten and graphic data may be transmitted via communication channels and recreated as hard copy', when was the concept first patented?

- ☐ 1843
- ☐ 1877
- ☐ 1905
- ☐ 1923
- ☐ 1931

## QUESTION 12

Babbage is best known for his work with calculating machines. Nevertheless, his genius extended beyond this. One of his inventions was used by the Russians in the Crimean War. Which?

- ☐ Mirror for indirect sighting of artillery
- ☐ Rocket for boosting projectiles
- ☐ Signalling lamp
- ☐ Railway dynamometer car

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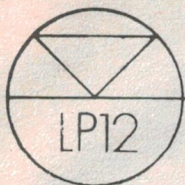
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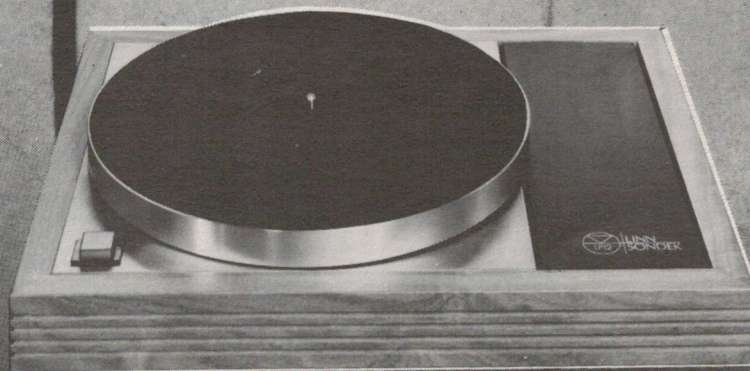


he beginning of a record playing chain is the record. If the turntable does not extract the musical information from the record, it is lost for ever. No amount of money spent further along the chain, on speakers for example, will recreate a signal which is lost at the beginning. In fact, you may only amplify original deficiencies by reproducing them more faithfully.

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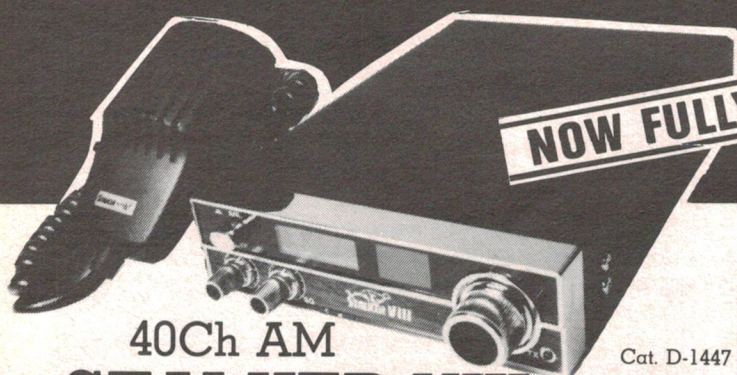
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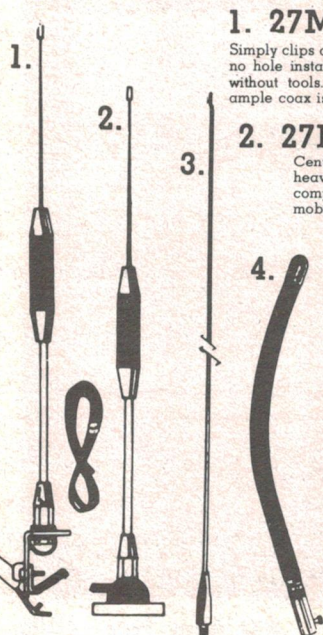
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# Setting up an outdoor PA system

Geoff Nicholls

This article covers the background theory and practical techniques you need to know to successfully set up and operate an outdoor PA system — with particular reference to the ETI-498/499 150 W PA project.

SETTING UP an outdoor public address system correctly can mean the difference between effective audience communication and totally indifferent results. And guess whose can get kicked when the system doesn't work as expected?

Before starting out, it is wise to know a little background theory to the various parts of the system. A little theory is introduced at each stage, to provide the appropriate background, so let's start off with sound propagation.

## Sound propagation

Sound propagates from a vibrating source in the form of longitudinal mechanical waves, which oscillate the particles in the medium along an axis in the direction of sound propagation.

The velocity of sound in still air is temperature dependent, and is approximated by the formula:

$$v = 20 \sqrt{273 + T}$$

where  $v$  = velocity of propagation in m/s  
 $T$  = air temperature in °C

Logic would suggest that the sound pressure level should fall off with increasing distance from the sound source by an inverse square law, because of the expanding area of the sound wavefront. In fact, additional losses are present due to dissipation of the sound energy by mechanisms too complex to discuss in this article.

These loss processes are frequency dependent, and lead to increasing attenuation of high frequencies with distance,

but fortunately they can be ignored for speech frequencies up to distances of about 100 m. The inverse square law is therefore adequate for *general* outdoor PA calculations. The decibel SPL formula is given by:

$$\text{dB SPL}(X) = \text{dB SPL}(R) + 20 \log \frac{D_R}{D_X}$$

where  $\text{dB SPL}(X)$  is the SPL in decibels at point X  
 $\text{dB SPL}(R)$  is the SPL in decibels at the rise to refraction or bending of the sound reference point R

$D_R$  is the reference distance from the sound source

$D_X$  is the reference to point C from the sound source

Temperature gradients in the air give rise to refraction or bending of the sound from its original direction. When the sound is refracted it bends towards the coolest region because the sound travels faster through the warmer region. This is analogous to a bimetallic strip which bends because of differential expansion.

Most outdoor venues are warmest near the ground during the day, and so the sound tends to bend upwards. One notable exception is over a large water surface, which during the day tends to be cooler than the air, and so causes sound to bend down towards the surface. This can cause sound to carry long distances over water.

Windy conditions cause sound to be refracted because of gradients in wind speed in a similar manner to temperature gradients. In general winds are slower near the ground, and this causes an upward bend when the sound is into

the wind and a downward bend when the sound is with the wind. Transverse winds have little effect on refraction, although irregularities in all winds cause scattering of the sound.

The ground will reflect a certain amount of sound and absorb the rest. The reflected part can be utilised to reinforce the direct sound and increase the overall level by up to 3 dB, depending on the ground surface.

## Setting up a PA

A PA system will be satisfactory if all the listeners can understand what is being announced without concentrated effort. The following criteria will generally allow this:

- The SPL at the listener is below the tolerable limit.
- The articulation of consonants is acceptable.
- The PA SPL at the listener exceeds the ambient noise SPL by at least 10 dB SPL.
- The sound at the listener does not contain annoying echo.
- The system is not 'howling'.

It is obvious that no one will remain in an area where the sound is so loud it is uncomfortable. Certain outdoor events involving high-powered motors (such as drag boat racing) can have an ambient level over 120 dB SPL, but only for a short period of time. It is impractical to have the PA loud enough to override such ambient levels. ►



The articulation of consonants depends primarily on the voice characteristic of the announcer. Successful announcers usually have good consonant articulation. It is possible to improve this factor by using a shaped filter response, such as the speech filter employed in the ETI-498.

The public address system sound must obviously be perceived as louder than the ambient noise, or it will be drowned out. An increase of SPL by 10 dB subjectively sounds twice as loud, and for outdoor set-ups forms a good signal-to-noise ratio to aim for at the limit of the PA coverage area.

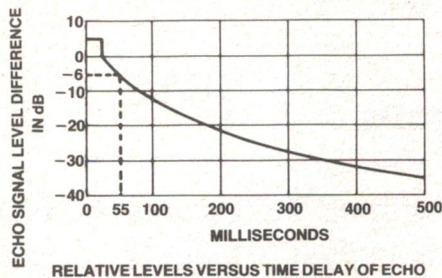


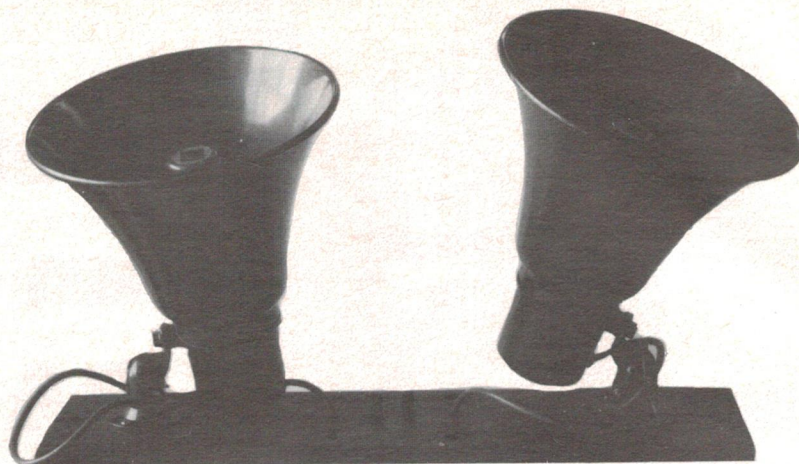
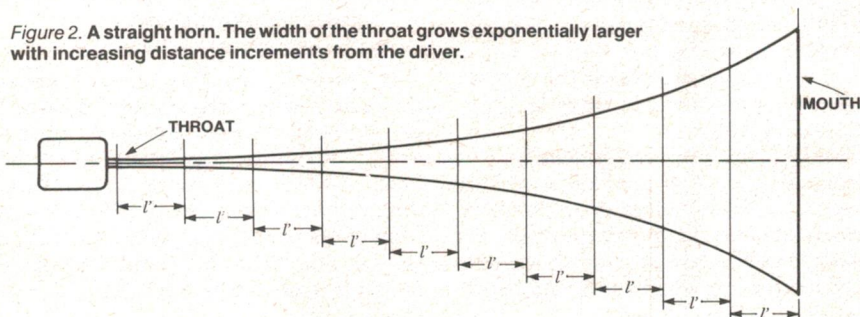
Figure 1. Echo level versus time delay for 10% audience annoyance, produced by Doak and Bolt (see References at end of article).

An echo will arise when there are unequal distances between the listener and two (or more) loudspeakers being driven by the same signal. An investigation by Doak and Bolt resulted in the compiling of a chart which allows us to estimate when an echo will become annoying to 10% of the audience. The chart plots the difference in SPL between the main signal and the echo against the time delay of the echo. An echo can also arise due to reflection off a hillside or building.

## Acoustic feedback

Nearly everyone will have experienced the howling that occurs when a microphone is placed too near a loudspeaker it is driving. This phenomena is acoustic feedback and arises when the total gain of a sound system from the microphone through the amplifier to the speakers and back to the microphone exceeds unity. This usually occurs at a single frequency or a few dominant frequencies, because of peaks in the system response.

Figure 2. A straight horn. The width of the throat grows exponentially larger with increasing distance increments from the driver.



The problem of acoustic feedback is complicated when public address systems are used indoors because of the room shape which gives rise to many resonances. Complex equalisers are employed to smooth out the overall response and therefore allow the sound level to be increased before feedback occurs. Indoor public address techniques will be the subject of a future article in ETI.

Acoustic feedback is less of a problem in open spaces since there is usually only direct sound present — little or no reverberation from reflecting surfaces. Correct system layout should avoid feedback problems.

## Speakers

The horn loudspeaker is by far the best type for outdoor use. Horns can be made weatherproof and have an efficiency of better than 20% compared to a few per cent for ordinary speakers. This allows an amplifier of lower power to be used, with consequent savings in electricity, physical size and weight. Horn speakers are available with inbuilt 100 V line transformers, usually with several taps to select different power levels. This allows some speakers to be placed closer to the audience and their output reduced to compensate without affecting other speakers on the 100 V line.

Horns are intrinsically limited in their frequency response, and their efficiency is inversely proportional to their bandwidth. PA horns are designed

to operate over the voice band at maximum efficiency. The horn itself is essentially an impedance transforming device which increases the acoustic loading on the driving diaphragm to allow better matching to the air. The shape of the horn is usually based on the exponential function and provides a cross sectional area which is dependent on distance along the horn by the formula:

$$A = A_0 E^{mx}$$

where  $A$  = area of cross-section at distance 'x' from throat  
 $A_0$  = throat area  
 $E$  = Naperian base (2.718128)  
 $m$  = 'flaring' constant.

The horn may be straight, as shown in Figure 2, or folded, as shown in Figure 3. The folded horn is physically smaller and is the most common type in low cost PA systems. Folding the horn reduces the efficiency slightly but increases the coverage or dispersion, which is usually an advantage. The straight horn has a long 'throw' and is useful for narrow sound coverage at greater distances but is more cumbersome, especially when you are 8 m up a ladder!

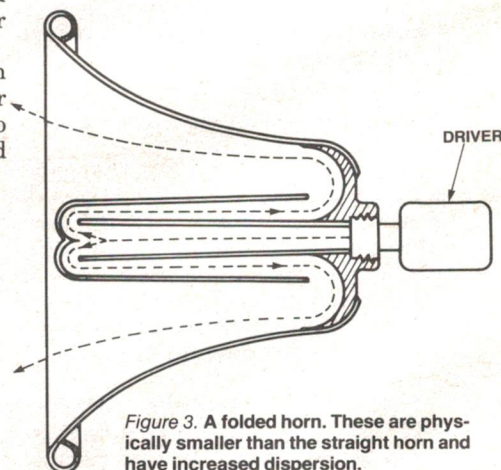
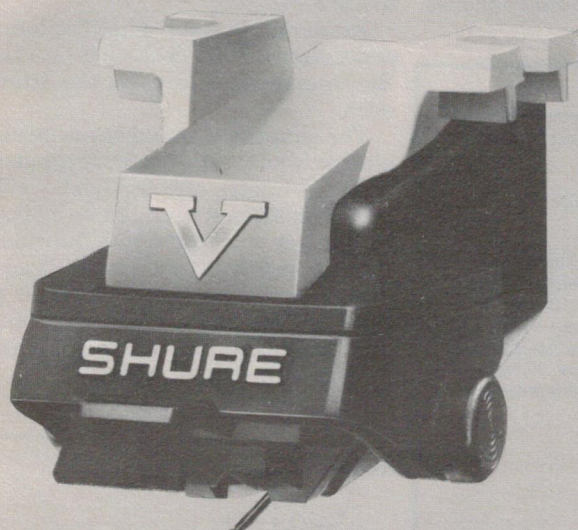


Figure 3. A folded horn. These are physically smaller than the straight horn and have increased dispersion.



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**Force Exerted By Dynamic Stabiliser:** 5 mN (0.5 grams)

**Tip Geometry (Typical):** Hyperelliptical,  $5\mu \times 38\mu$  (0.2 mil  $\times$  1.5 mil) long contact

Trackability At 10 mN (1 gram)	Tracking Force (Typical in cm/sec peak velocity):
400Hz: 30cm/sec	5kHz: 80cm/sec
1kHz: 46cm/sec	10kHz: 60cm/sec

**Total Trackability Index (TTI):** 91.7 minimum

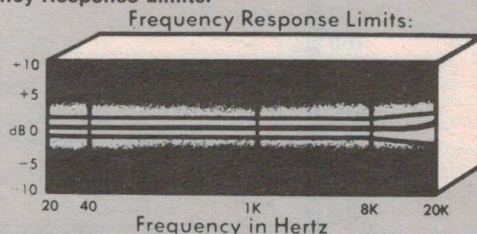
**Vertical Tone Arm Resonance:** Less than 5dB rise at 14Hz in SME Series III Tone Arm (without SME damper)

**Channel Balance:** Within 1.5dB

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10kHz: 18dB or greater

**Output Voltage (Typical):** 3.2mV RMS at 1kHz at 5cm/sec peak velocity

**Frequency Response Limits:**



**Recommended Load:** 47 kohms in parallel with 250pF (includes tone arm wiring, connecting cables, and preamplifier input)  
Capacitive loading from 100pF to 400pF will cause negligible change from the recommended 250pF loading

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**Inductance (Typical):** 330mH at 1kHz

**Cartridge Weight:** 6.6 grams

**Replacement Stylus:** V15V: VN5HE, Nude Hyperelliptical tip,  $5 \times 38\mu$  (.0002  $\times$  .0015 in) Black serial numbers  
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## Microphones

A good microphone forms the heart of a good PA system and vice versa. The most suitable type for outdoor use is the unidirectional, low impedance dynamic microphone. This type is rugged and can withstand the abuse an outdoor setup will inflict. The directional characteristic is extremely important when the announcer is within the range of the speakers, and can make a big difference

to the sound level attainable before feedback occurs. The low impedance microphone can also be used with a longer cable than the high impedance types, and will not pick up as much interference.

## System layout

The overall performance of an outdoor PA is dependent on the location and type of loudspeakers and microphones.

### PERCEIVED SOUND PRESSURE LEVELS

The human sense of hearing is stimulated by small variations in the air pressure at the ear. In order to perceive a sound the local pressure variations must conform to a limited range of frequencies and a minimum amplitude of vibration.

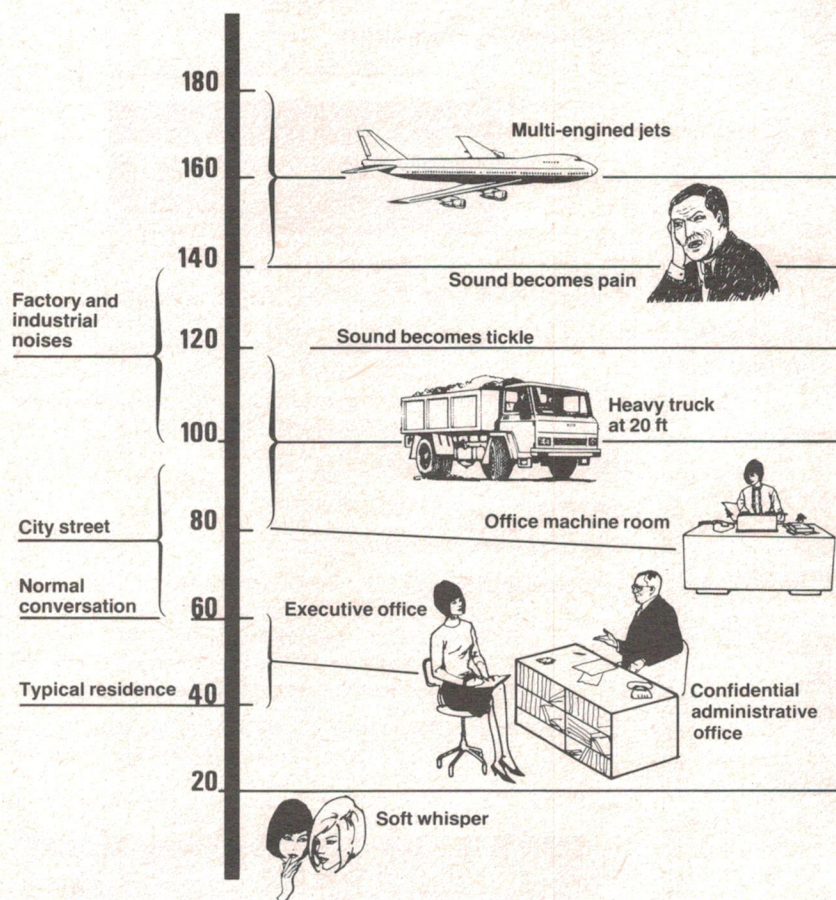
The amplitude frequency range is usually quoted as 20 Hz to 20 kHz, although the precise range depends on individual characteristics, particularly age and when the ears were last cleaned out! The minimum amplitude of pressure variations required for the perception of a 1 kHz sound in a young person's ear is about 20  $\mu\text{N}/\text{m}^2$  (or 20  $\mu\text{Pa}$ ). Since this level represents a lower limit it is used as a reference for sound pressure levels and is given the value 0 dB SPL.

The largest sound pressure variation that can be tolerated without pain is about 100  $\text{N}/\text{m}^2$ , which can be expressed as:

$$20 \log_{10} \frac{100}{20 \times 10^{-6}} \text{dB}$$

or about 134 dB SPL.

It is interesting to compare this to the variation in air pressure that often accompanies the approach of a storm, when a drop of 10 000  $\text{N}/\text{m}^2$  can occur in a few hours! Such slow changes in pressure cause our ears no distress because the inner ear is vented to the atmosphere through the Eustachian tube, which equalises the pressure on the eardrum.



- For a sound to be perceptibly louder or softer, it must be changed by three decibels.
- A noise twice as loud or half as loud is a change of ten decibels.
- A reduction in noise of a few decibels in the low noise region (administrative office) is not significant. The same change at high sound levels (office machine room) is significant.

The placement of the amplifier and microphone is usually dictated by the facilities at the venue, i.e. commentators are found in control towers, dias' etc., which are fixed structures. If mains power is needed, the amplifier position is limited by the length of available extension cords.

**WARNING!** Check the integrity of extension cords before allowing anyone to use the system.

Assuming that the amplifier location is determined, the next job is to arrange the horn speakers to cover the listening area.

The simplest layout is the centralised cluster, where all speakers are together. This eliminates any time delay effects and simplifies wiring. To be effective, the cluster must distribute the sound so that nearby listeners are not deafened and distant listeners are able to hear the PA. This will require a high mount and possibly the use of straight horns to reach the furthest listeners.

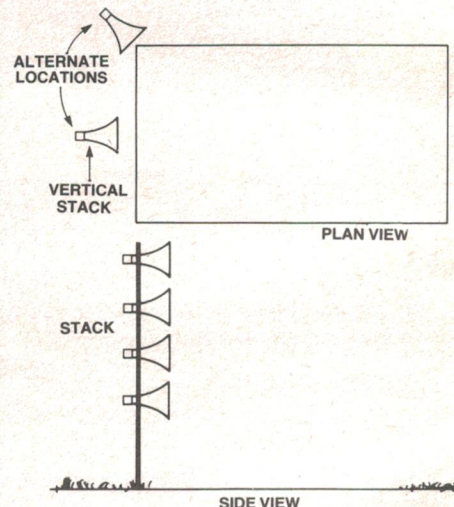


Figure 4. The centralised cluster of speakers. Note the speakers should point slightly downwards.

Venues suitable for a centralised cluster are ovals and parks where the length-to-width ratio is less than about 2 to 1. The speakers should be positioned away from the commentary along the short end position and should point slightly downwards from the horizontal in a vertical stack. If they must be sited along the long side of a rectangular area then an additional vertical stack should be added and splayed about 75° apart.

It may be necessary to use long-throw straight horns to reach the furthest areas, these should be mounted on the top of the stack.

Additional 'side fill' horns are used to service listeners behind the main coverage area.

The vertical stacking results in a horizontal 'fan' of sound and reduces wasted acoustic energy upwards and downwards.



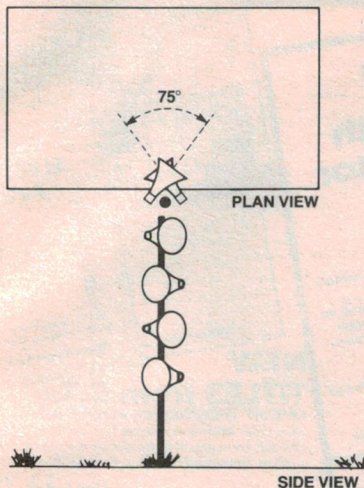


Figure 5. Mounting a cluster along the side of the area to be covered requires the horn throats to be angled at about 75° and they must overlap.

Some venues are not suited to a centralised cluster. For instance, river-side events tend to concentrate the crowd in a thin rectangle along the bank. Such cases require multiple loud speakers, and care must be used in planning the sound sources to avoid annoying echo effects.

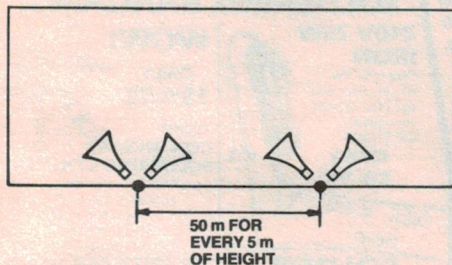


Figure 6. Horn positioning for covering a long, narrow area.

The best results are obtained by using a large number of speakers evenly spaced along the long axis operating at fairly low levels, but this is expensive. The higher the speakers can be mounted the further apart they may be spaced. As a rule of thumb, each 5 m of height allows a speaker spacing of 50 m.

## Wiring

I have found that figure-8 lighting cable is well suited for wiring 100 V loud-speaker systems. Although somewhat overrated for audio power levels, the cable is durable and cheap, and is easy to strip. Many connections are made with the strip-twist-tape technique atop ladders, and a light fiddly cable is a hassle to use. It is convenient to have fixed lengths of pre-cut cable to avoid constantly breaking and rejoining a single cable.

I have mounted pairs of horn speakers on wooden battens with spring connectors mounted on them. Holes in the battens allow the speakers to be tied to various poles or trees with rope or spare

figure-8 cable. The spring connectors prevent progressive shortening of the cable from the speaker due to repeated cutting and stripping of the end of the cable.

All budding sound or PA engineers

should get a copy of what is almost 'the Bible' — "Sound System Engineering", by Don and Carolyn Davis, published by Howard Sams (USA). This is currently available through ETI Book Sales. See pages 28-29 this issue.

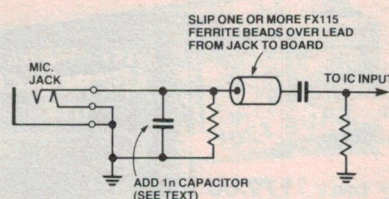
## RF INTERFERENCE SUPPRESSION — TECHNIQUES



Interference pickup on speaker leads may be cut by winding part of the lead, nearest the amplifier terminals, on a ferrite rod — available at many parts suppliers.

Public address amplifier systems may be prone to RF interference from a variety of sources — and the source may be unknown or hard to track down. Sometimes the source is well known but impossible to eliminate — a nearby AM broadcast transmitter, for example. CB or marine transceivers in the vicinity of a PA system are notorious sources of annoying intermittent interference. But it's not the fault of the 'offending' transmission; the characteristics of modern solid state devices are the major culprits.

A number of techniques can be employed to protect a PA amp from interference. As it will depend on the individual application, we leave it to the constructor how much, or how little, interference protection to incorporate.



Adding RF suppression to the low level inputs.

### THE 'FRONT END'

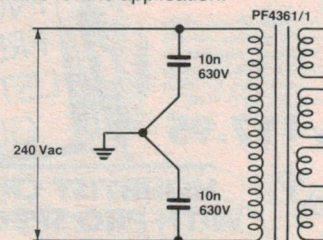
The low-level input stages are particularly prone to RF pick-up. There are two components you can add quite simply to protect each low-level input. Firstly, a ferrite bead, such as the commonly available FX115 type, can be slipped over the lead running between the jack socket and the pc board. Secondly, a 1n 'greencap' capacitor can be soldered directly across the input jack socket terminals. If the leads of this capacitor are cut to a length of 25 mm, the capacitor will have a broad series resonance around 27 MHz, greatly aiding suppression of CB and marine radio interference. These components may be added to both MIC 1 and MIC 2 inputs.

For the AUX input, a greencap with a value between 2n7 and 10n should be used.

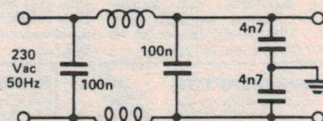
### THE 'BACK END'

Long runs of loudspeaker cable have the annoying tendency to act as antennas. 'Choking off' the RF once it gets on a cable run can be problematical. One of the most effective methods is to wind that part of the cable nearest the amplifier speaker term-

inals on a ferrite rod — such as is used for transistor radio loopstick antennas. This makes a very good broadband RF choke, but it *must* be installed as close to the amplifier output terminals as possible. There's nothing critical about it, but the ferrite rod should be at least 100 mm long, preferably longer. Ferrite rod in 200 mm lengths, 9.5 in diameter, is commonly available and quite suitable for the application.



Adding interference suppression on the mains input. The value of each capacitor may be anything between about 4n7 and 100n. They should be rated at 630 V or 1 kV.



Circuit of a mains input filter. The chokes should have an inductance between 5 mH and 50 mH and be capable of carrying up to 2 A. The capacitors may be greencaps or ceramic types rated at 630 V or 1 kV.

### MAINS-BORNE INTERFERENCE

Apart from radio interference coupled into mains cables, light dimmers, motor controllers and switch contacts on mains equipment connected to the same line as the PA amp can cause a variety of clicks, pops and buzzes to be heard on the system. Proprietary mains filters can be obtained and often prove very effective. Alternatively, you can build a filter into the PA amp.

One of the simplest suppression methods is to connect a 10n/630 V greencap or ceramic capacitor from each side of the mains transformer primary to the chassis — at the same point. Three-pin mains plugs can be obtained with capacitors installed and may be quite effective. A 'pi' filter can be built up, as shown in the accompanying circuit, and installed in the amp's chassis.



## CORRECTION ...

In the Dick Smith Kit Catalogue (inserted in EA last month and available from all Dick Smith stores) two kits were shown with their magazine references transposed. The Earth Leakage Detector Kit (Cat K-3315 @ \$45.00) was published in ETI while the Infra Red Light Beam Relay Kit (Cat K-3380 @ \$59.00) appeared in EA magazine. Also on the Playmaster Speaker Kits page, readers should note that the 200mm system shown is not the new style, but the original. The 250 and 300mm systems are the new style as photographed.

## Measure It ...

### 20k/v - 20 Ranges!!

It may be a budget multimeter, but this one has top performance for the price: an amazing 20,000 ohms per volt & it's under \$20! Huge easy-to-read scales with 20 ranges. Comes complete with batteries, test leads and instructions. Cat Q-1020.

**ONLY \$19.95**

### 10 MEG FET INPUT

For the professional who wants the lowest circuit loading ... you want the highest input impedance. The FET input multimeter gives you a huge 10M input impedance on DC voltage, and a highly respectable 1M on AC voltage. Batteries, test leads & instructions supplied. Cat Q-1200

**ONLY \$72.00**

### RF PROBE

Extend the useful range of your multimeter way up into the RF range with this great probe. Frequency response is 150kHz to 30MHz (ref. 500kHz). Comes equipped with banana plug for direct multimeter connection. Cat Q-1138

**ONLY \$17.95**

**OVER 2,000 SOLD!**

## HOBBYIST CRO WITH PRO SPECS

This oscilloscope is ideal for the laboratory, classroom, field service, bench service in assembly centres and, of course in hobby applications. Solid state electronics ensures extremely low drift and fast warm up. Features: ● Retrace blanking ● Fibreglass PCB ● Lower threshold triggering ● Sharper focus ● AND A FREQUENCY RESPONSE TO BEYOND 6.5MHz. Cat Q-1280

### HANDY BNC ADAPTOR

Adapt your input terminals on the Dick Smith Laboratory Oscilloscope from 'banana' socket to BNC type. Cat Q-1281 ... **ONLY \$9.90**

### SPECIFICATIONS

Usable bandwidth: DC to 6.5MHz plus.  
Vertical deflection sensitivity: 10mV per div.  
Horizontal deflec. sensitivity: 500mV per div.  
Time base sweep freq: 10Hz to 100kHz in 4 ranges  
Synchronisation: Internal & External.

### BARGAIN PROBE SET

Get features of a probe set you would pay \$\$\$\$ more for with this versatile probe set. Will suit virtually any CRO. Cat Q-1245 ... **ONLY \$32.50**

## AMAZING SCOOP PURCHASE

### 9 DIGIT RED LED DISPLAY

Ideal for the finishing touch to that special project you've been working on. Cat Z-4155

### SAVE! SAVE!

### AMAZING FLASHING LED

Inside this standard size (5mm) red LED is a tiny microcircuit which causes it to flash. Think of the dozens of applications where a flashing warning is needed! Cat Z-4000

and now LESS than HALF price



**25¢**  
or **5 for \$1.00!!**  
normally 45¢

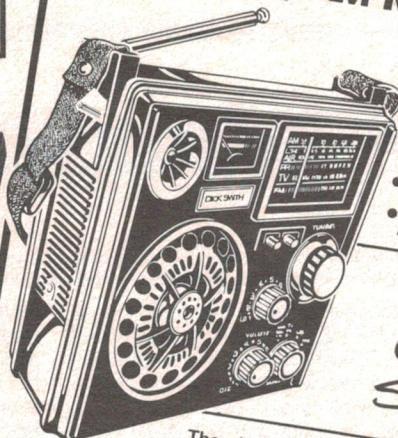
**SAVE \$\$\$**  
OVER \$100 WORTH!

### Electrolytic Capacitor Pack

250 capacitors in the one pack. Over \$100 worth of RB & RT electro caps. Amazing value! Cat R-7110

**ONLY \$9.95**

## WHY PAY MORE? Look at what you get with the Dick Smith Communicator VHF/AM Radio



- 6 bands with handsome 'military' look
- 240V AC & 6V DC (battery) op.
- Complete with multi-section adjustable telescopic antenna for vertical/horizontal polarization
- Unique tuner meter, doubles as battery strength meter.
- Earphone jack for private listening (earphone supplied)

**OVER 6,000 SOLD!**

**ONLY \$65.00**  
**INCLUDES FREE VHF LISTENING GUIDE!**

There's a whole different world of radio you probably haven't even discovered yet! It's 'up there' on VHF! This superb portable VHF Communicator Radio will introduce you to the world of VHF — without missing out on the radio stations you also want to listen to. Its six bands cover the AM & FM broadcast stations, through the full 40 channel CB band, up to the VHF bands from 107 to 147 MHz.

These bands include the entire aircraft bands plus the 2 metre amateur band, police, fire, ambulance frequencies, two way car radio, taxis etc. Cat D-2833



**ONLY \$179.00**  
**WAS \$199.00**

## LAST CHANCE! MICROACE KIT

Build your own computer for less than \$100 with this superb kit but you better hurry! Cat K-6500

**VERY LIMITED STOCKS! NOT IN ALL STORES**

**\$99.50**  
**WAS \$199**  
**SAVE \$100!**

## Hobbyist uses for our new POCKET COM II

Not only for kids, this superb, compact walkie-talkie can be used in many other ways. Putting up an antenna for your TV? Want to know what the reception is like down below? Mums, want to call in hubby for lunch? Whenever you want to communicate with someone you can't hear or see, use this handy transceiver. Cat D-1101

**ONLY \$9.95**



## DON'T SHOUT (Except at the pub!)

### 6 station intercom

Fast, efficient means of communication within your home, office, factory, even small hospitals, motels etc can find them useful.

Up to 3 simultaneous conversations are possible with this system. Each unit can call any other connected up. Superb styling. Each unit sold separately. Cat F-1310

**ONLY \$46.50 ea**  
**5 or more ... \$39.00**



### AND 12 stations too!

Expand your intercoms as your requirements grow. With this superb system you can have up to 6 simultaneous conversations, with all the stations being 'master' type - i.e. any station can call another. Each unit sold separately. Cat F-1320



**INTERCOM TERMINAL BOARD** Enables you to wire up your 6 or 12 station system with a minimum of fuss. Specially imported for the above systems, it can be mounted anywhere convenient. Cat F-1321 ... **\$61.00**

**ONLY \$61.00 ea**  
**5 or more ... \$55.00**

## NEW! 4 SECTOR ALARM MODULE

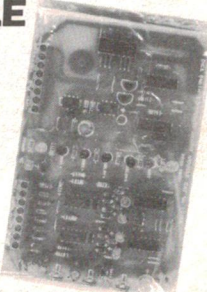
Protect your home and valuables! Designed in Australia for Dick Smith Electronics especially to suit Australian conditions, this alarm can protect 4 areas at once, or independently of each other, or in any combination you desire. And just look at the features:

- Instant or delayed siren
- Built in siren sound generator will drive 2 speakers
- Adjustable entry, exit and alarm time periods.
- 'Wire out proof' sensing system
- Easy to install and operate

Cat L-5056

**and it's only \$59.50**

**WHY PAY MORE?**



## NEW TITLES from E.T.I. CIRCUIT TECHNIQUES VOL's 1 & 2

Save time, effort and money! The circuit you need will probably be in one of these two excellent books. If not a suitable replacement will be. Cat B-3690 and B-3691.

**ONLY \$4.75 ea**

### ELECTRONIC PROJECTS FOR CARS

Over 25 projects for the car enthusiast to build. A must for any constructor who takes his/her car seriously. Cat B-3680

**ONLY \$3.95**

### HOW TO BUILD ELECTRONIC GAMES

Build your own arcade-type games! They look just like the professional ones. Hours of fun! Cat B-3682

**ONLY \$3.95**

### ELECT. PROJECTS FOR YOUNG SCIENTISTS

Over 15 specialized projects for the specialized hobbyist, including a geiger counter, sound level meter and more. Cat B-3681

**ONLY \$3.95**

## TWO FANTASTIC SOLDERING BARGAINS!

### 240V 25W IRON

Plug into any power point and get 25W of heat very quickly. Cat T-1300

**ONLY \$9.75**

**OVER 10,000 SOLD!**

### WOW!

**ONLY \$59.50**

### TEMP CONTROLLED SOLDERING STATION

A professional soldering station at a hobbyists price! Fully approved by the Energy Authority, comes complete with iron, holder and cleaning sponge. Cat T-2000

### DICK-WICK

Known to one and all this is a specially treated copper braid that is used to remove solder from the PC board by capillary action. Fast, clean and very efficient. Cat N-1682 ... 1-9 ... \$2 ea  
10 or more ... **\$1.70 ea**

### SOLDER

Top quality corrosion free

1.25mm (18g) hobby pack ...

Cat N-1638 ... **\$1.20**

1.25mm (18g) 200 grams ...

Cat N-1619 ... **\$4.95**

0.71mm (22g) hobby pack ...

Cat N-1636 ... **\$1.20**

0.71mm (22g) 200 grams ...

Cat N-1623 ... **\$4.95**



# GET PRICES ON COMPONENTS LIKE YOU HAD A RELATIVE IN THE BUSINESS!!



## NOW A COMPLETE RANGE OF 100V GREENCAPS

We've now expanded our range of Greencaps to give you the best deal. Don't buy them elsewhere when you can get them at these ridiculously low prices.

Values in uF	Cat No.	Price	Price 10 up
.001	R-2010	25c	20c
.0012	R-2012	25c	20c
.0015	R-2015	25c	20c
.0018	R-2018	25c	20c
.0022	R-2020	25c	20c
.0027	R-2027	25c	20c
.0033	R-2035	25c	20c
.0039	R-2040	25c	20c
.0047	R-2045	25c	20c
.0056	R-2050	25c	20c
.0068	R-2055	25c	20c
.0082	R-2060	25c	20c
.01	R-2065	25c	20c
.012	R-2070	25c	20c
.015	R-2075	25c	20c
.018	R-2080	25c	20c
.022	R-2085	25c	20c
.027	R-2090	25c	20c
.033	R-2095	25c	20c
.039	R-2100	25c	20c
.047	R-2105	25c	20c
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.27	R-3545	25c	20c
.33	R-3550	25c	



# Polk RTA-12B loudspeaker system

"The Polks are different and the Polks are impressive" — but they're certainly not the 'reference monitors' the manufacturers claim them to be, according to Louis Challis.

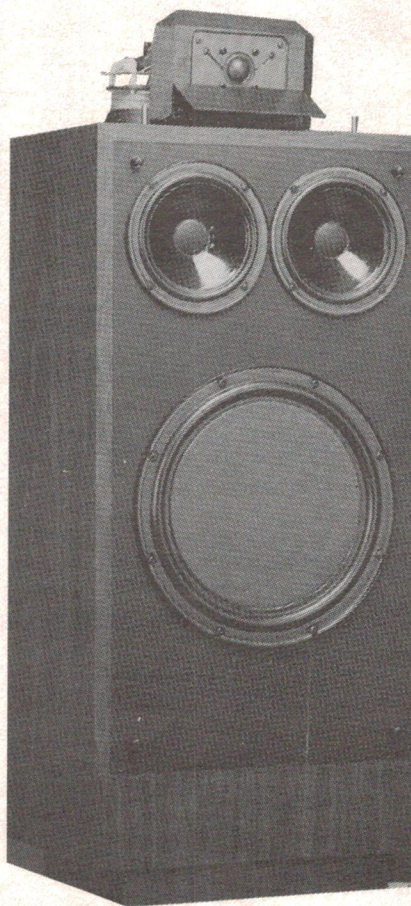
**Louis Challis**

OVER THE LAST six years the name Polk Audio has repeatedly stared out at me from advertisements in American hifi magazines. Most of these ads have revealed unusual configurations, which by and large tend to indicate that the company's designers are searching for new and innovative approaches to achieve improved acoustics.

The company's chief designer, Mathew Polk, formed the company in 1972 with two fellow graduates of John Hopkins University. From the outset his design philosophy has differed from that of his contemporaries in that he strongly believes that, "Reproduced sound can never sound the same as the original live sound... therefore the loudspeaker designers must make products that can accurately *represent* that recorded material rather than the live performance." He also strongly believes that whilst objective measurements can put his designs into the correct ballpark, they cannot provide sufficient data to correct for the emotive design factors which he rates so highly in his designs. Not surprisingly, Polk has already earned a widespread reputation and is attracting a large following in the American market. Many buffs are convinced of the quality of his designs and more particularly by the quality of the sound that his speakers produce.

## The RTA-12B

This particular model, the RTA-12B, is apparently an upgraded version of the RTA-12, for which the manufacturers originally claimed excellent phase response, good stereo imaging and a very wide frequency response.



## POLK RTA-12B LOUDSPEAKER SYSTEM

Dimensions: Height 1002 mm; width 402 mm; depth 303 mm.  
Weight: 26 kg  
Price: Rrp \$1450  
Manufactured: In Baltimore, USA, by Polk Audio  
Distributor: Leisure Sound Pty Ltd,  
401 Pacific Hwy, Artamon  
NSW. (02)438-4166.

The RTA-12B is an unusual-looking speaker. Instead of the normal 200 mm, 300 mm or even 350 mm diameter woofer, this unit incorporates a pair of long throw 170 mm diameter woofers mounted side by side at the top of the cabinet. These are positioned above a 300 mm diameter passive radiator, which is centrally located on the front panel of the enclosure, behind a black open-weave cloth-faced cover panel. The concept of using such small drivers for the main woofers is not in itself unusual, as Aram Bose, of the American Bose Corporation, and the Swedish Audio Pro sub-woofer systems have each shown that properly designed small drivers are capable of working at frequencies as low as 20 Hz.

The significant difference between this system and other loudspeaker systems is, however, that the two drivers are not designed to share the load equally. The outer woofer in each pair is designed for work up to only 600 Hz, whilst the inner woofer is designed to extend its output up to 2 kHz, at which point the tweeter takes over. The designers claim to have taken this unusual step in order to reduce the 'comb filtering' effect that a pair of drivers produces in their radial polar plot. This cyclical cancellation from two drivers handling the same signal only occurs off the main axis, where the diffraction effects of the two speakers result in enhancement and notching of the primary signal. This phenomenon results in a polar plot not unlike the petals of a daisy, and becomes more complex because the phase response at these same points and even directly on axis must also be adversely affected as a result of this novel 'design feature'.



At frequencies above 2 kHz a single 25 mm dome tweeter is used to cover the decade extending from 2 kHz to 20 kHz. This tweeter is mounted in an equally unusual configuration, in that it sits on top of the main cabinet mounted in a small baffle with chamfered edges (to reduce diffraction effects) and a sloping ramp-like panel immediately below the driver cone. This ramp provides a hard reflecting surface to direct the high frequency energy forwards, whilst simultaneously reducing unwanted reflections from the top of the cabinet.

The tweeter baffle is mounted on a separate sub-plate, which screws down on a large air-cored crossover network. This is arranged as much for its 'high technology' visual effect as for the mounting convenience and possible ease of adjustment. The main air-cored inductors of this crossover are wound on two large-diameter moulded plastic bobbins mounted side by side on the top of the main cabinet. These inductors are used to support a printed circuit card, onto which a series of smaller inductors, capacitors and resistors are mounted. The whole crossover assembly is screw-fixed to the top of the cabinet, which is then covered by a small rectangular cloth-covered frame that matches the main speaker grille on the front of the enclosure. The two tweeters and their crossover networks come packaged in a third box. These have to be assembled by bolting them onto the top of the enclosure with thumb screws. The inter-connection between the two assemblies is made by means of a plug which latches into a socket on top of the main cabinet.

The cabinet is well finished with plastic veneer. Electrical connections are made by means of pairs of universal terminals, colour coded and set into moulded recesses on the back panels.



The crossover network and tweeter come as a single unit which mounts to the top of the bass enclosure and connects via a plug.

The tweeter and the main drivers are located approximately 900 mm above the floor, which I have found to be an excellent position for good stereo imaging and good listening comfort.

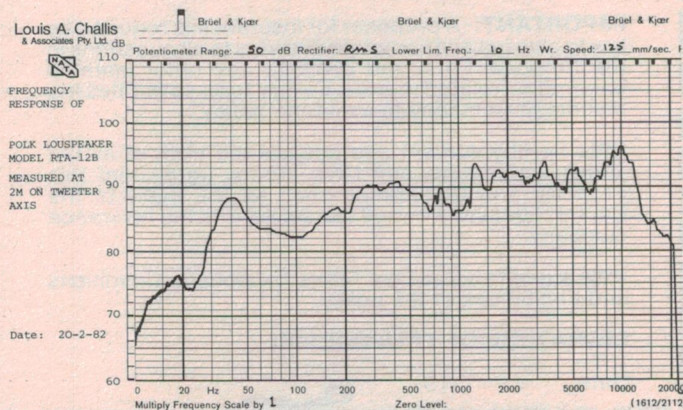
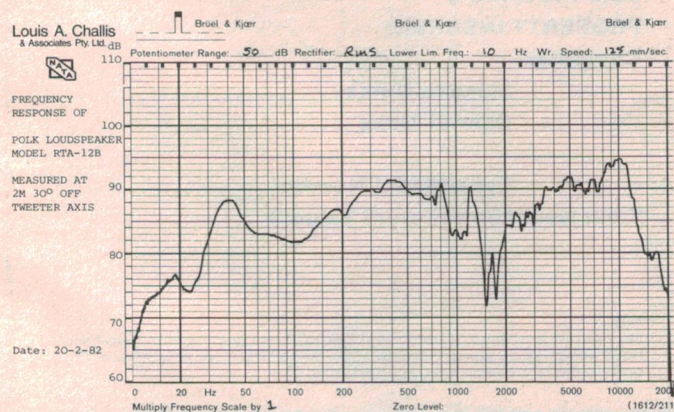
The manufacturers carefully label the back of each of the speakers to indicate which is left and which is right. They also recommend placing the speakers approximately 1.2 metres from the wall to achieve the best and smoothest frequency response. This recommendation ties in neatly with the results of the objective testing.

## On test

The objective testing proved to be something of an eye opener. The bottom end

of the frequency response in the anechoic room was reasonable and confirmed that the speakers can provide a good response when the reflective components from the rear wall and floor are arranged to supplement the direct sound. The rest of the spectrum is not as smooth as I would expect from a loudspeaker sold as a 'reference monitor'. It is the other objective performance results that highlighted the unusual aspects of the design.

The impedance curve really caught my attention. The low threshold of 4 ohms shows that the speaker is capable of extracting more power from your amplifier than you would expect or may even want, as many new Japanese amplifiers are not designed for 4 ohm loads.





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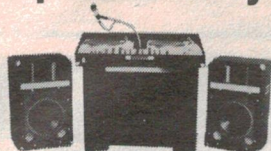
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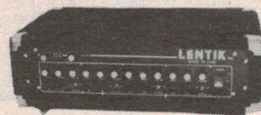
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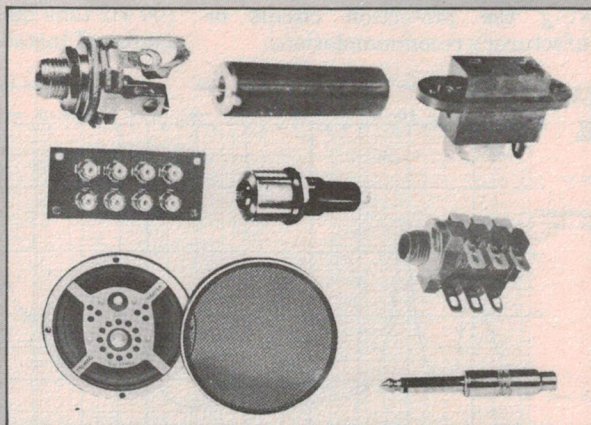
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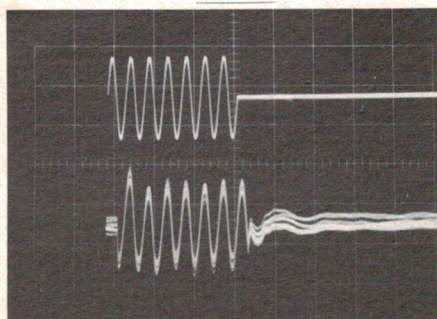
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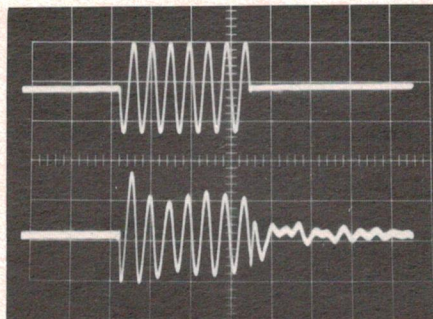
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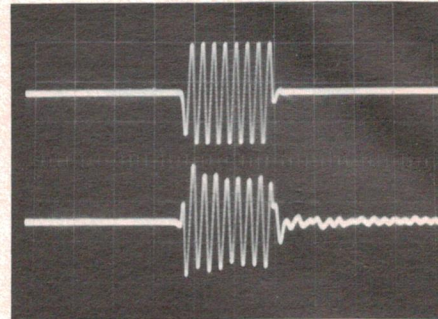




100 Hz (20 ms/div.)



1 kHz (2 ms/div.)



6.3 kHz (0.5 ms/div.)

Tone burst response of Polk RTA-12B loudspeaker system (for 90 dB steady state SPL at 2 m on axis). Upper trace is electrical input; lower trace is loudspeaker output.

The impedance curve exhibits dominant peaks at 20 Hz, 55 Hz and 3.25 kHz, and a rising impedance curve response all the way up to 20 kHz. A wide trough occurs between 200 Hz and 1200 Hz, with the lowest impedance level being approximately 4.4 ohms at 1 kHz. Under these conditions the system should be designated as a 4 ohm loudspeaker system, and it would be definitely unwise to try to parallel it with a second set of speakers on any normal amplifier.

The 20 Hz resonance is unusual, and is caused by the passive radiator, which resonates at that frequency. The output of this passive radiator clearly shows up in the frequency response curve with a notch at just below 30 Hz, but with a relatively smooth output response in the low frequency end down to a nominal 45 Hz cut-off frequency. Fortunately the amplifiers we use for both the lab testing and for our subjective testing are quite happy with 4 ohm loads, and each is also capable of delivering up to 400 watts per channel of power without complaint. However, not all amplifiers are designed for 4 ohm outputs and it would be unwise to parallel this speaker system with another without carefully checking the protection circuit or manufacturer's recommendations.

Considering the size of the main driver, the distortion characteristics in the speaker are reasonable. A sound level of 90 dB at 2 m results in 13% distortion at 100 Hz, 1.6% at 1 kHz and 4% at 3 kHz. The 13% distortion figure at 100 Hz is rather high on the left hand unit, but was slightly lower on the right hand unit at 9.5%.

The most interesting objective test result was that for the phase response. This shows the most complex set of phase interactions I have yet seen from any speaker system at the low frequency end of the spectrum. The number of reversals is really to be expected, and although not audible, is nonetheless a direct result of the choice to use two low frequency drivers working in parallel, with an even more unusual crossover network. The manufacturer's claims for exceptional phase linearity in this speaker in the low frequency region are not borne out, although the phase response in the 1 kHz to 20 kHz region is somewhat better.

Even the tone burst response test, which normally gives similar information to the decay response spectrum, provided useful information about the characteristics of this system. The 100 Hz tone burst shows a remarkable degree of instability, which comes as a

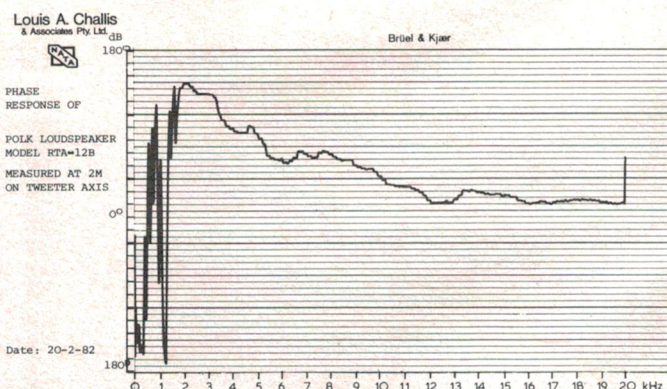
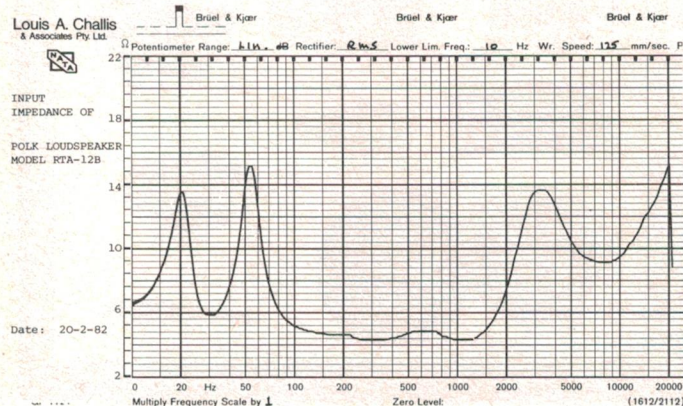
result of the passive radiator inducing a low frequency modulation component on the top of the 100 Hz sinewave. This made it difficult to photograph a steady tone burst response. The higher frequency tone burst exhibited a different set of responses, with obvious resonances apparent.

The decay response spectrum shows significant peaks at 1500 Hz, 2.5 kHz, 5 kHz and a series of pronounced peaks in the 10 kHz region and 16 kHz region.

## Subjectively

The objective testing did not provide the sort of confidence I would like, and would worry most purists even without listening to the speaker. The subjective response of the speaker was unusual in that we expected a higher level of audible distortion to be apparent than we actually found.

The first thing you notice with the Polk speakers is that they are unusually 'bright', with a presence that was typical of the JBL, Altec Lansing and AR speakers in the early 70s. Most people like that sort of presence, some people don't. The best test of colouration is to use our standard voice record test, which still seems to be one of the easiest subjective ways of picking speaker



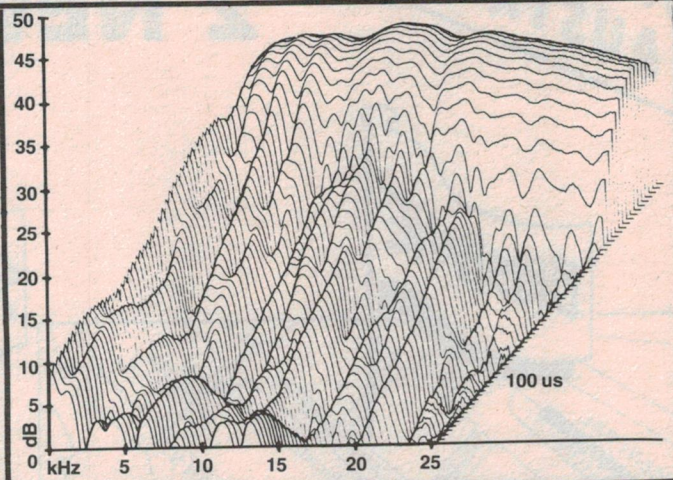




# MEASURED PERFORMANCE OF POLK AUDIO MODEL 12B

SERIAL NO. 15623/22 - 10458

<b>FREQUENCY RESPONSE:</b>	30Hz	-	16kHz
<b>CROSSOVER FREQUENCIES:</b>	600Hz	-	2.2kHz
<b>SENSITIVITY:</b>	7.0 VRMS = 12.2 Watts (nominal into 4Ω)		
(for 90dB average at 2m)	(@ 84dB)		
<b>HARMONIC DISTORTION:</b>	100Hz	1kHz	6.3kHz
(for 90dB at 2m)	2nd	-17.8	-37.5
	3rd	-34.3	-42.5
	4th	-47.5	-50.0
	5th	-49.9	-49.8
	THD	13.0%	1.6%
<b>INPUT IMPEDANCE:</b>	100Hz	5.2 Ω	1.4%
	1kHz	4.4 Ω	
	6.3kHz	9.3 Ω	
	Minimum at 300 & 1kHz 4.4 Ω		



colouration. The RTA-12B does not come through this test particularly well.

Considering the small size of the drivers, the low frequency performance of these speakers is relatively good and they are able to handle the Swedish High Fidelity Institute test record with reasonable aplomb. At power levels exceeding 40 watts input there was a distinct speaker break-up, with a much higher level of distortion than normal. Playing the new Ultragroove record 'The Digital Fox' from Volume One of the late Virgil Fox's organ recitals, I was suitably impressed that the Polks could do reasonable credit to a record which is at its best when played through a system requiring sub-woofers. This particular record produces very high levels at frequencies as low as 25 Hz and consequently constitutes a rugged test

for most speaker systems.

With the Telarc 10042 'Pictures at an Exhibition', the RTA-12B can handle 200 watts of power and produce reasonable outputs of in excess of 115 dB at 2 m on axis. Under these conditions the distortion is readily audible and I was tempted to turn the power level down out of deference for my ears rather than for the speakers themselves. With percussion, brass, and woodwind instruments the speakers take on a slightly strident characteristic, which is readily discernible and which leaves one with a feeling of roughness rather than the smooth performance I have grown to expect from this record. With Barbra Streisand singing 'Woman in Love' on a half-speed mastered CBS record (CBSH162), Barbra shows quite clearly with her voice the degree of colouration that the speakers produce.

The Polk Audio RTA-12B speakers are not exactly what they claim to be, and are most certainly not a reference speaker. Although Polk Audio may claim that much care and thought went into their design, it is my opinion that a little more thought and care would make them ever so much better. At a recommended retail selling price of \$1450 they are relatively expensive.

The Polks are different and the Polks are impressive, and these characteristics could form the basis of what may yet develop into a monitor loudspeaker system.

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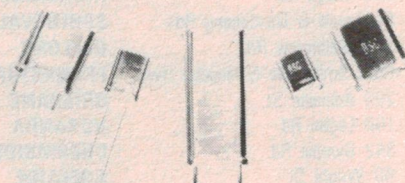
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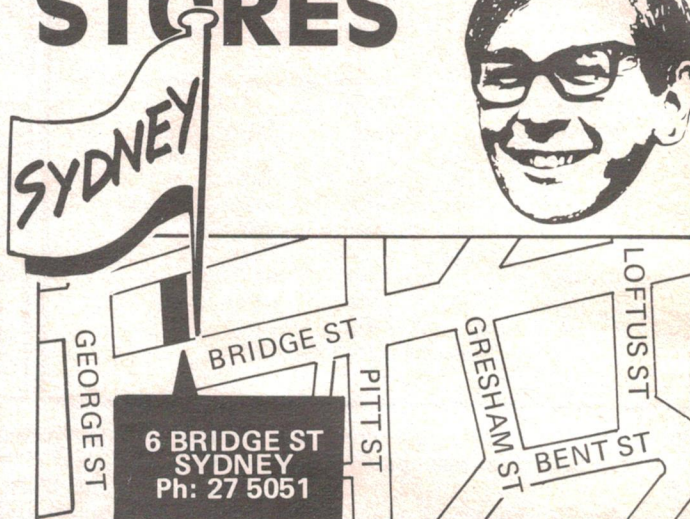


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Quite often, the products we advertise are so popular they run out within a few days. Or unforeseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert (after all, we're human too!). Please don't blame the store manager or staff: they cannot solve a duck strike on the other side of the world, or fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give the store a call first... just in case. Thanks.



Dick Smith & Staff





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Send orders to: ETI, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011. Phone: (02)33-4282.

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# ORGS

... and I promise to  
build you every ETI project  
you ever want!

NOW THE STORY can be told. Now, that is, that once-Great (or is it Great-again?) Britain has reclaimed the Falkland Islands (nee-Malvinas). It all started like this ...

The day after the momentous announcement that Argentina had invaded the Falklands, and that the British Prime Minister had announced they'd take them back, the following joke did the rounds of the ETI office, and no doubt many other places ...

"Did you hear about the latest pub video game sweeping Great Britain?"

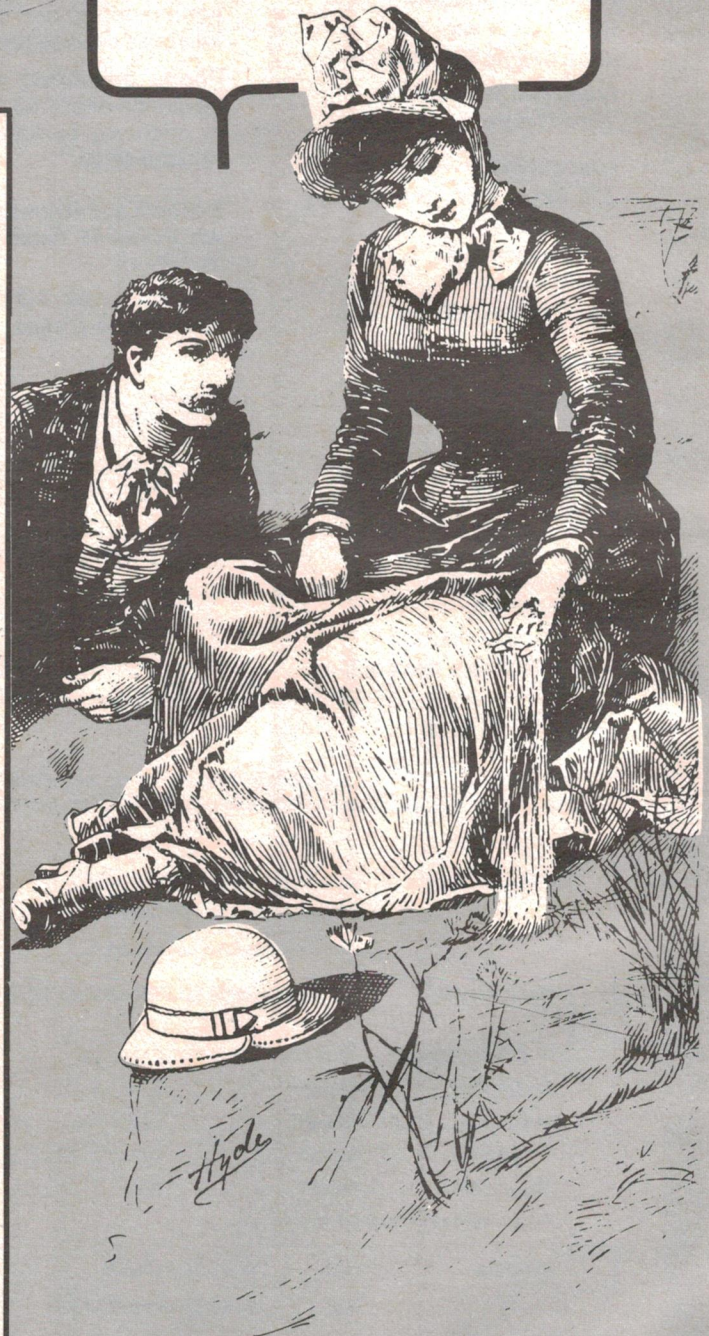
"No"

"Falklands Invaders!"

Ho, ho, very funny and all that, but remarkably ironical. A tiny news item, tucked away in one of those international weeklies, was later reported to us. Apparently, the week after announcement of hostilities between Britain and Argentina, an Irish pub video games manufacturer had a game on the market called — wait for it — 'Kill the Argies'!

The 'targets' were sombrero-wearing invaders and you 'shot' them down with 'ships' that looked remarkably like Harrier jump jets, plus the odd battleships, so we were told.

Said manufacturer, it is reported, was politely told the game was '... in bad taste' and they were requested to withdraw it from the market. They did.





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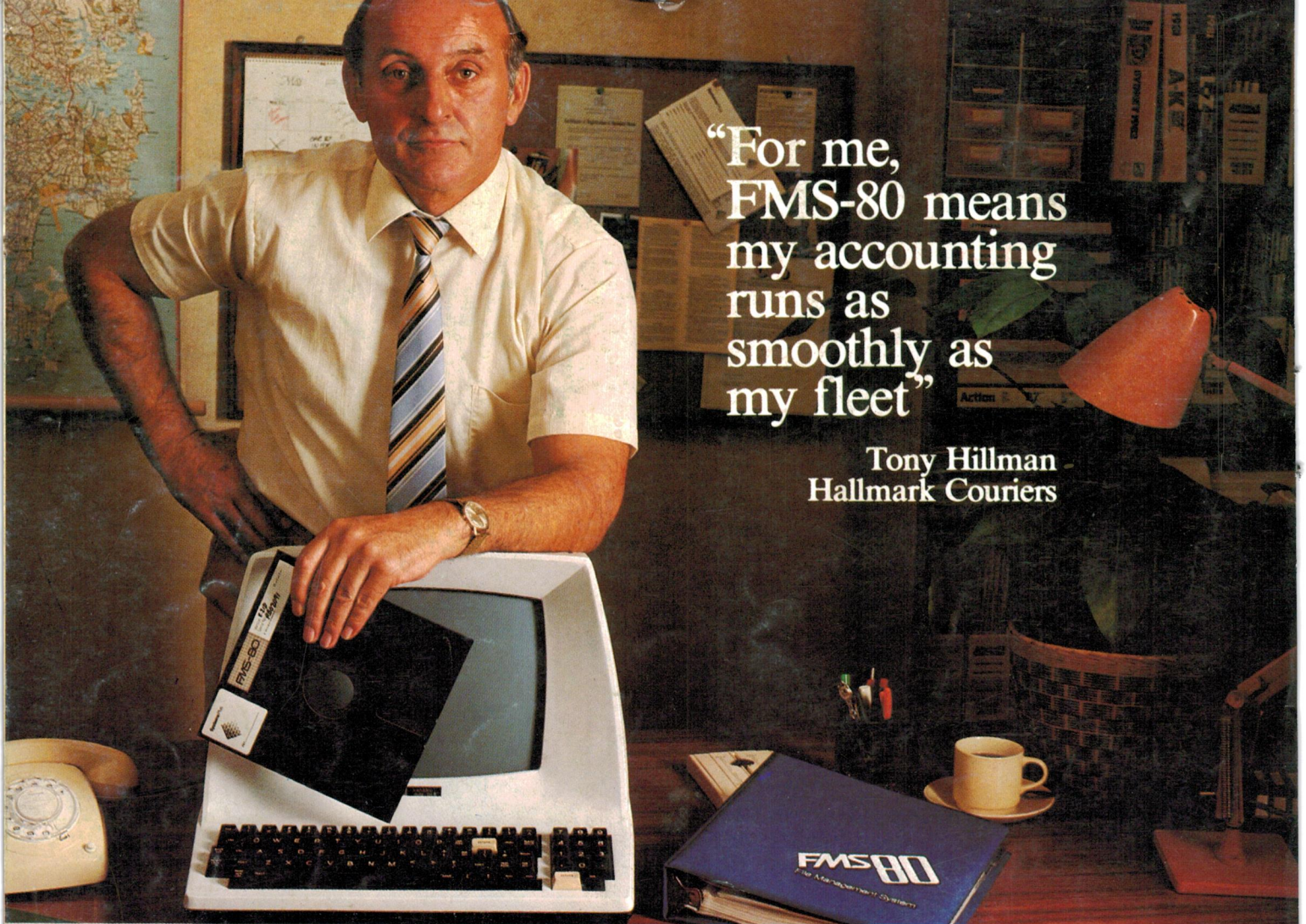
Enter the state of higher fidelity with the new Walkman 2 stereo player, the world's smallest Hi-Fi. It's a sensational way to listen to music on cassettes and raise your awareness of sound. Walkman is so light it practically feels weightless. So small it's hardly bigger than

the plastic case that cassettes come in. And so personal, with headphones that weigh next to nothing, that Hi-Fi has never been more intimate. The new Sony Walkman. It can make your experience of sound infinitely wondrous.

The World's Smallest Hi-Fi  
**WALKMAN**

SON 0114



A man in a light-colored short-sleeved shirt and a striped tie stands behind a desk. He is holding a 5.25-inch floppy disk in his right hand, which is resting on a vintage computer keyboard. The computer monitor is visible behind the keyboard. On the desk, there is a rotary telephone on the left, a blue binder with 'FMS80' on the cover, a cup of coffee on a saucer, and a red desk lamp. The background shows a cluttered office with papers and a filing cabinet.

**"For me,  
FMS-80 means  
my accounting  
runs as  
smoothly as  
my fleet"**

**Tony Hillman  
Hallmark Couriers**

## **your filing system wastes time and money. Here's the solution... FMS-80**

By early last August, Tony Hillman had problems. Tony heads the fastest growing courier service in Sydney. In just over 2 years his turnover had grown over 700%. Servicing the advertising industry, he knew speed, service and efficiency were crucial. He knew time meant money and he knew he was wasting it. A manual job record and accounting system was holding the company back; he and all the staff worked back until 1am to get out the month's invoices. And because he had to pay his drivers fortnightly, his cash flow situation was getting difficult. He had to invoice fortnightly. Tony needed a solution. One which could cope with 387 clients and over 15,000 transactions per month and run his invoicing and accounts. And have flexibility for future growth.

FMS80 was the answer for Tony. The FMS80 data management system gives him total integration of his day to day

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For you, FMS80's power and flexibility might mean being able to carry out a stock valuation in only two minutes. Or being able to add crucial supplier codes you forgot the first time. Or maybe tailoring reports to have just the information you want. Or it might be FMS80's ability to work in with WordStar™, to produce text and chart reports.

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FMS80 will very likely tap straight into your existing files. This means flexible financial forecasting with complete control of future variables. Answer all those 'what if' questions straight off your existing files. Can you see FMS-80 working for you? Then contact us right away for further information. Or give us the real challenge; let us show you just how FMS-80 can work in your application.

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